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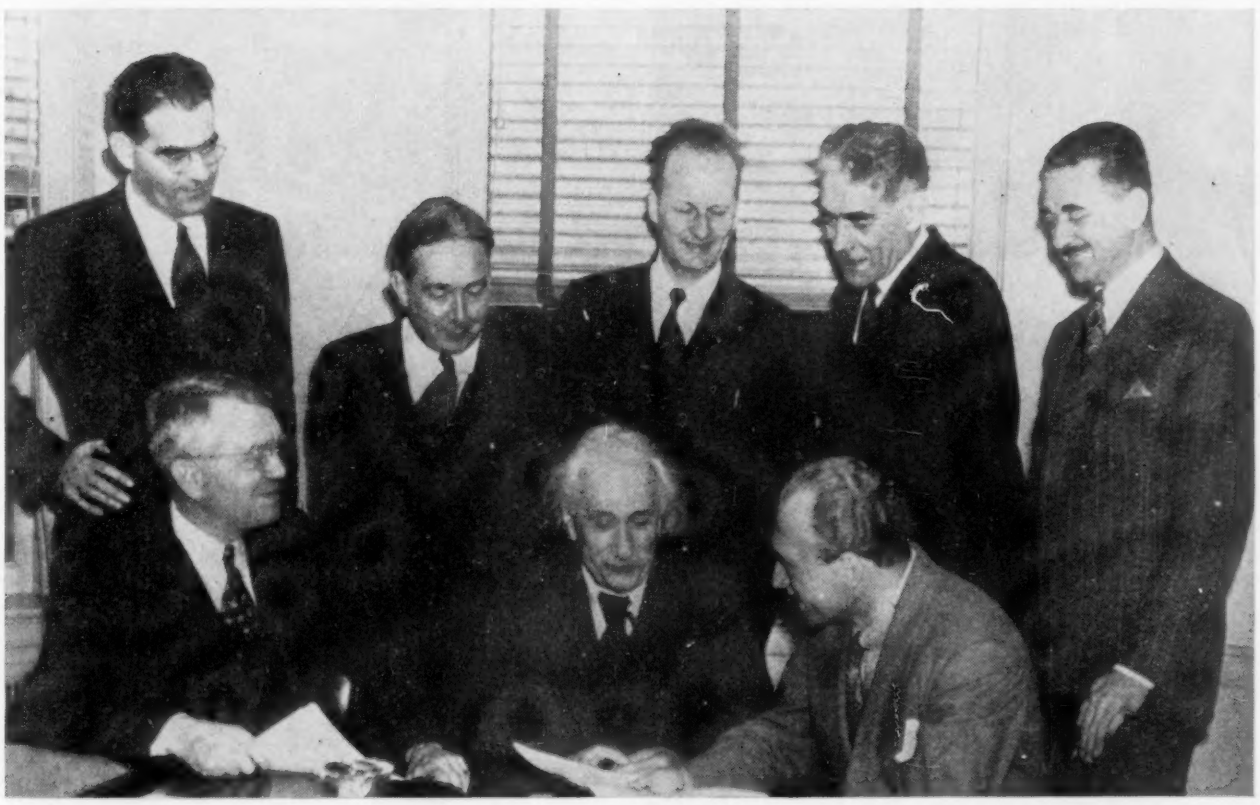
SCIENCE

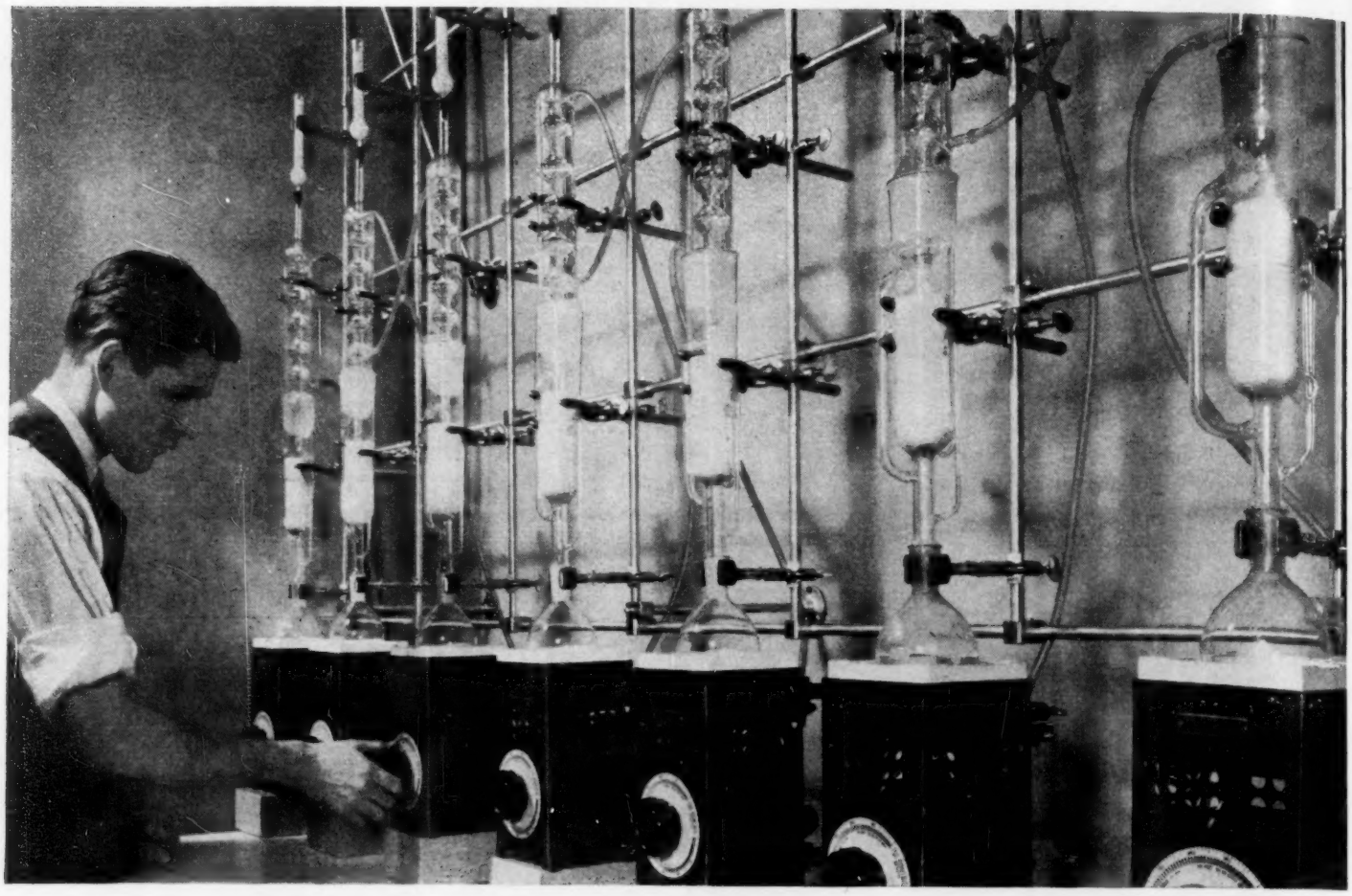


Members of the Emergency Committee of Atomic Scientists at a meeting in Princeton, 17 October. The Committee is considering means of raising $1,000,000 to conduct an educational campaign on the social implications of our new knowledge of nuclear energy.

Left to right, seated, Harold C. Urey, University of Chicago; Albert Einstein, Institute for Advanced Study; Selig Hecht, Columbia University; standing, Victor F. Weisskopf, M.I.T.; Leo S. Szilard, University of Chicago; Hans A. Bethe, Cornell University; Thorfin R. Hogness, University of Chicago, and Philip M. Morse, on leave from M.I.T.

Calorie Intake and Industrial Output

H. A. Kraut and E. A. Muller



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SCIENCE

Vol. 104, No. 2709 Friday, 29 November 1946

Calorie Intake and Industrial Output

H. A. Kraut and E. A. Muller

Kaiser-Wilhelm-Institut für Arbeitsphysiologie, Dortmund, Germany

IN THE FIELD OF THE PHYSIOLOGY of nutrition the energetic side of metabolism had the primacy for many years. M. Rubner, R. Tigerstedt, F. G. Benedict, and others studied thoroughly the calorie consumption of man in various kinds of activity. Afterwards, the interest in the energetic problems dropped, since it was not difficult to produce enough calories for the majority of men. Heavy work was reduced more and more by technical devices, and the progress of world economy and world trade made famines uncommon. Since in most parts of the world there was no calorie problem, interest was directed to other fields of the physiology of nutrition, especially vitamins.

This situation was entirely changed with the beginning of war, which induced a nutrition experiment of the widest range. It generally was possible to prevent the occurrence of avitaminoses with the help of scientific knowledge. The requirements for calories, however, could not be satisfied in many parts of the world. At the beginning of the war rations were graduated in order to economize as much as possible, this graduation becoming more and more elaborate as want increased. In the summer of 1943 rations in Germany had to be decreased far below the actual requirements. A man without supplements could do little to adapt himself to the decreased rations. The worker with his extra allowance, however, could lower his calorie consumption by lowering his output and restore the balance between intake and output. This situation in Germany provided an opportunity to study in many cases the connection between calorie intake and industrial output.

In the description of our observations the calories contained in food are separated into two groups according to their role in metabolism. The first group includes calories necessary for the metabolism of the body during strict rest and those required for digestion, which together amount to 1,600–1,800 calories per day according to size, weight, and food intake. The second group consists of work calories, needed for muscular activity of every kind.

In 1942, 20 workmen, fed entirely by their factory, were occupied with the erection of an embankment inside the works. Their task was composed of dumping debris out of railway cars and changing the rails to advance the points of dumping. A measure of the work done was given by the number of tons of debris dumped per hour and man. At the beginning the workmen did not receive the rations for heavy workers. They had, besides their calories for resting metabolism, 820 work calories per day and dumped 1.5 tons per hour. Our observations, results of which are given in Fig. 1, started after several months of work of this kind. Neither the workmen nor the personnel charged with the supervision and inspection of the workers were informed about our investigations. Three weeks later the workmen received the rations for heavy workers except when difficulties in transport made this impossible. This resulted in unequal nutrition. The output of the workmen changed parallel to these enforced variations in available work calories. After one year 2.2 tons per man and hour were dumped with an average of 1,300 work calories. The body weight of the workers increased about 4 kg. during that year, proving that the capacity for work, given in the rations for heavy work, was not fully utilized. Since the termination of the embankment was urgent, the workers were promised cigarettes for greater production. At first, 2.5 tons per hour was the minimum production for which this premium was awarded; after several weeks the premium was graduated, the maximum being given for 3 tons and later on even for 4 tons. This induced a considerable in-

This paper came to us from the hands of Dr. David B. Dill, professor of industrial physiology, Harvard Graduate School of Business Administration. Dr. Dill met the authors in September 1945, while in Germany on a technical mission for the Quartermaster Corps, U. S. Army. The authors then had reecived permission from the British authorities to reopen their laboratory at Dortmund. The laboratory had functioned at Bad Ems and Dietz during the last year of the war.

crease of output, 3 tons soon being attained by nearly every man; after the last increase of the premium limit the average output reached 3.4 tons. The premium system lasted for the last half year of the embankment construction, during which time the 20 workers lost, on the average, 3.5 kg. of weight.

The result of these observations is clear. In the time without premiums production varied directly with available calories, yet the actual production differed enough from the energy equivalent of the rations to allow an increase in body weight. With the awarding of cigarette premiums the proportionality between output and available calories was lost at once. Output surpassed so much the range of calorie possibilities that the deficit had to be made up continuously from the very substance of the body.

A second investigation was undertaken in 1943 with a group of 31 miners. These miners were 20–30 years of age when they started working as miners, and at the time of the study they had just finished their training as "cutters." During the training period a total of 2,800 calories, allowing 1,200 work calories per day, was given, securing a daily output of 7.0 tons of coal per man. They used, therefore, 170 work calories per ton. At our suggestion these workers received 400 extra calories per day and thereby increased their daily output to 9.6 tons per man. Expending now 155 work calories per ton, they lost in six weeks, on the average, 1.2 kg. of body weight. The number of extra calories was then raised to 800. In consequence, the output increased a little (to 10 tons), and the body weight slowly returned to its original value. The actual requirement is, therefore, to be found between 155 and 200 calories per ton.

Further experiments were conducted in steelworks in 1944. On our advice 400 extra calories per day were given to the workers living in a camp. Workmen occupied on a steam hammer thereby increased their output 22 per cent, simultaneously increasing their body weight slightly. Sixteen other workers were occupied on a 1,500-ton press, already being used at its capacity; hence, the production of these workers could not increase, and in three months the body weight increased from 67 kg. to 72.5 kg. on the average.

The best example of the connection between nutrition and output is given by the coal production of the Ruhr district during the war. In Fig. 2 are plotted the calories of the rations during the war and the output of the workers in the pits of the Ruhr coal mines from September 1939 to September 1944. The total calorie consumption of the miners working in the pits before the war, depending on the job, varied from 3,600 to 4,800. In agreement with these figures the output of the first year of war was but little lower, the ration then being 4,200 calories. From 1,150 to 1,200 work calories were needed per ton of coal mined. These needs cover the whole number of miners employed underground and not merely cutters, as in our investigation of 1943. When in the course of the second year of war rations were cut somewhat, the output went down exactly as expected from the fall in available work calories. The first major cut in rations, which occurred in April 1942, was not followed immediately by a decreased output, as shown in the two upper curves of Fig. 2. Instead, the workers, in trying to keep up production, contributed calories out of their body substance. The lower curve, which

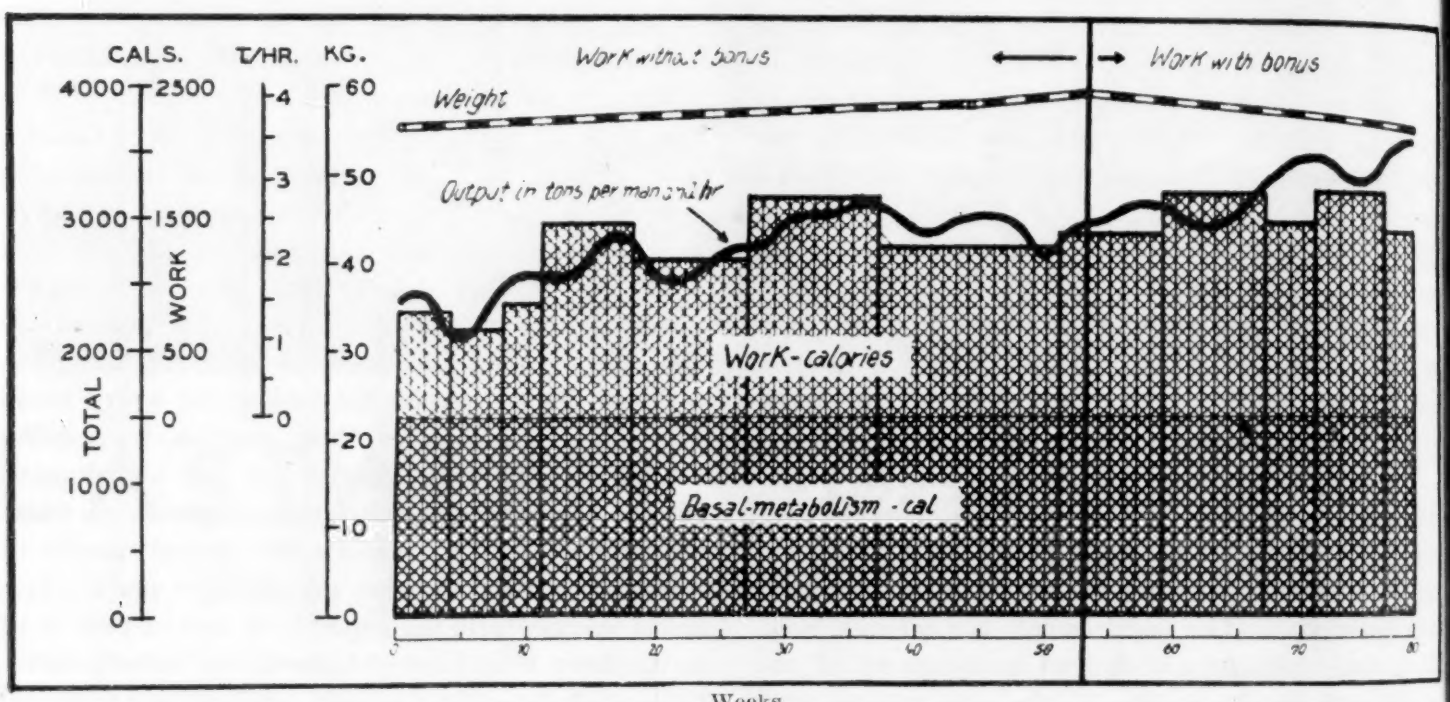

FIG. 1

shows the calories available per ton of coal mined, fell rapidly from April 1942 down to 900 calories per ton. Very soon, however, the curve rose and by autumn of 1942 again exceeded 1,100 calories per ton. From the summer of 1943 to the end of the observations in the autumn of 1944 it was always between 1,150 and 1,200 calories, its original height. The production of a single plant did not always show the connection with the calorie supply because of the numerous troubles caused by war. However, our review of the whole production of the Ruhr district demonstrates quite clearly that the fall of coal output during the war was primarily due to the cuts in rations.

masters, and engineers, all of whom are short about 500 work calories per day. Still more difficult is the situation of housewives, fed the basic ration but needing 800 work calories per day.

As a result of our observations it is clear that every professional activity requires a fixed amount of calories. No activity can be continuously greater than in accordance with the caloric intake; otherwise, loss of weight is induced, and this lowers the capacity, finally stopping work entirely. A regular control of body weight in industrial workers is, therefore, a good measure of their calorie supply. The output on varying rations is unthinkingly adapted to the available

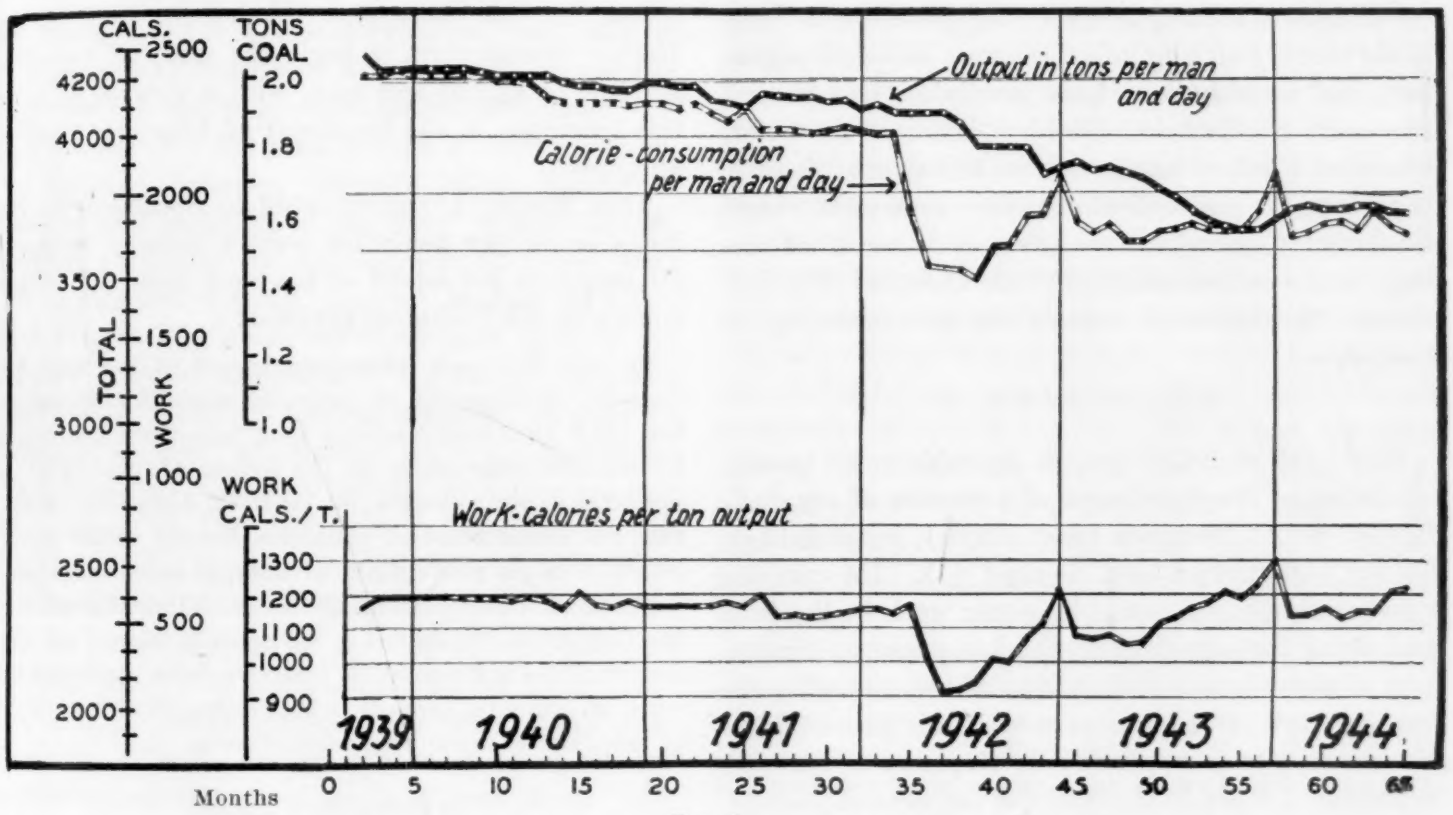

FIG. 2

Exactly the same observations have been made after the war, during the resumption of work. Investigations of the calorie consumption of workers in bridge-building works in Dortmund in the autumn of 1945 demonstrated that the work done was in accordance with the rations provided. The allowances of 2,200 calories for men doing heavy work and 2,700 calories for those doing the heaviest work permitted about half the amount of peacetime work. Bad as this result is from the point of view of production, it really touches the workman's health only slightly. With his rations and extras he first satisfies his resting metabolism and the needs of his leisure hours. He does as much work with the rest as is actually possible. The consumer of the basic ration of 1,500 calories, however, can barely keep up his resting metabolism. For his leisure and professional work he is bound to use his body substance or secure illegal food. These conditions apply to clerks, assistant chemists, designers, work calories by the worker himself, the body weight being kept constant.

Our results prove that rationing of food also means rationing of industrial production of a country. Control of production is diverted from management to those responsible for food administration, who often cannot see the consequences of their decisions. Under existing conditions the job of one man often has to be done by two or three men with a higher total wage cost.

There is a lack of knowledge about the work a man is able to do with the calories available. Engineers appointed to fix the times for piece work and for job performance have calculated these times and the resulting flow of the manufacturing process under the assumption of unlimited food supply. Rationing makes these calculations as worthless as efficiency tables of an airplane motor with insufficient fuel. Today's situation is, therefore, rightly paraphrased by the sentence: Reconstruction is a problem of calories.

Penicillin Aerosol: Contribution of the Chemical Warfare Service to Medicine

R. W. Hufferd, Colonel, CWS. (Res.)[1]

Bradford, Pennsylvania

IN A SUMMARY OF CERTAIN CONTRIBUTIONS of the Chemical Warfare Service to medicine, which appeared in *Science* (*4*), the role played by the Chemical Warfare Service in developing penicillin aerosol therapy of the lungs is not mentioned. For the sake of historical interest which penicillin aerosol therapy now merits, it seems desirable at this time to mention certain facts connected with this subject. It is not generally known that the investigations leading to the use of penicillin aerosols in the therapy of lung infections were initiated, organized, and developed in both preclinical and clinical phases by the Technical Division, Office of the Chief, Chemical Warfare Service. Since this type of therapy is perhaps the one medical procedure used most widely in everyday peacetime medicine as a result of the impetus given the subject by the Chemical Warfare Service, the historical aspects warrant recording in some detail.

Preliminary Phase

In the fall of 1942 it seemed desirable to me to take advantage of the experiences of a member of my staff, Lt. Col. H. A. Abramson (then Major), in the field of aerosol stabilization and therapy (*1*). He was instructed to carry forward his early work in the field and apply his experiences with low-pressure generation of aerosols to certain phases of the general problem, only two of which concern us in this presentation. These two phases were: (1) development of suitable nebulizers for use in the field for the aerosol therapy of chemical warfare casualties of the lungs, with particular reference to relief of bronchial obstruction; and (2) development of methods for the treatment of secondary infections of the lungs following exposure to chemical warfare agents of all types.

At a meeting held in Washington in August 1942, in the Office of the Chief, Chemical Warfare Service, this program was discussed in detail and was shortly implemented (September 1942) by a direct contract from the Technical Division to the Long Island Biological Association, Cold Spring Harbor, New York. Support was given to this project by a grant from the Josiah Macy, Jr. Foundation to cover the more medical aspects of the investigation. The work of the Cold Spring Harbor group progressed favorably. On 10 March 1943, a conference was called by the Technical Division at Edgewood Arsenal, Maryland, on "Aerosol Therapy of Gas Casualties of the Respiratory Tract." At this meeting the feasibility of aerosol therapy of the lungs by antibiotics was discussed again, and tentative plans were drawn up to proceed with the experimental phase of penicillin aerosol therapy of the lungs. As soon as technical problems, such as choice of nebulizers and particle-size distribution during nebulization therapy, appeared to be solved, Lt. Col. Abramson directed the Cold Spring Harbor investigators to begin the study of penicillin aerosols in animal and man, with a view to utilizing this technique in the treatment of lung infections of all types.

Thus, Bryson (*5*) gives credit to Abramson for the initiation of the penicillin aerosol therapy program. He states, in his report of the work done under contract with the Technical Division:

> Perhaps the most interesting aspect of the work has been the development of penicillin mists for inhalation. We know that many serious lung infections are caused by bacteria susceptible to the action of penicillin. It appeared to our colleague, Major H. A. Abramson (M.C.), that the introduction of penicillin directly to the site of infection might give certain advantages over conventional methods of administering the drug. Clinical studies at the College of Physicians & Surgeons in New York City and St. John's Hospital in Brooklyn have confirmed the value of penicillin aerosols in the treatment of some kinds of chronic and acute pulmonary disease.

Intermediate Phase

Bryson, Sansome, and Laskin, of the Cold Spring Harbor Laboratory, reported their results on penicillin aerosol to the Technical Division early in 1944. It appeared that their results were of the greatest importance. Their findings were as follows:

(1) Simple commercial nebulizers of the DeVilbiss No. 40 type could be used to nebulize penicillin solutions, even in concentrations as high as 200,000 units/cc.

(2) Penicillin was not reduced in potency by the air flow through the nebulizer. Oxygen, similarly, had no deleterious effect.

(3) Penicillin aerosols penetrated into the lungs.

(4) Penicillin from the aerosols diffused into the blood stream and could be recovered in the urine.

(5) Appreciable amounts of penicillin were absorbed through the lungs.

[1] The writer was chief of the Research Branch, Technical Division, OCCWS, at the time this project was initiated.

(6) Concentrations of penicillin much higher than those required for therapeutic efficacy could be safely inhaled by man.

These investigators were instructed by the Chief, Technical Division, to publish their findings at once because of the general importance of their data (*6*). The Chief of the Technical Division, Brig. Gen. Kabrich, thereupon instructed Lt. Col. Abramson to organize and preside at a meeting of interested agencies and to have the Cold Spring Harbor group report their findings to these agencies so that proper coordination of interested research organizations could be made. This meeting, on "Generation of Aerosols for Therapy of the Respiratory Tract," was held on 22 May 1944 at Edgewood Arsenal, with representatives from the following organizations attending: Professional Service, Surgeon General's Office; Preventive Medicine, Surgeon General's Office; Bureau of Medicine and Surgery, U. S. Navy; Camp Detrick, Maryland; Office of the Air Surgeon; Chemical Warfare Laboratory, Ottawa, Canada; Medical Director, Macy Foundation; Biological Laboratory, Cold Spring Harbor; Aerosol Laboratory, Columbia University (Division 10, NDRC); Medical Research Laboratory, Edgewood Arsenal; and Medical Division, Office of the Chief, Chemical Warfare Service. At this meeting the chairman, Lt. Col. Abramson, pointed out that the Technical Division had, through its own researches and through the Biological Laboratory, found that two types of aerosol therapy of the respiratory tract were possible: (1) where low-quantity effects were desirable, and (2) where high-quantity effects were more important. For the first part, it was pointed out that suitable commercial nebulizers had been studied and that further studies of nebulizers were in progress. For the second type, the ordinary atomizer, with a proper tip, could be used directly to the trachea and bronchi. After discussing the various items connected with aerosol therapy of the lungs, the following action was taken: "Study of penicillin aerosols will be undertaken at Columbia University in the Department of Medicine by Dr. Barach, with the support of the Macy Foundation, in cooperation with the Technical Division and the Cold Spring Harbor group."

Clinical Phase

Dr. Barach and his co-workers at Presbyterian Hospital, New York City, collaborated with the Technical Division and with the Biological Laboratory. Their paper (*3*), which was closely followed by that of Olsen (*7*) and others, showed (1) that experimental peritonitis in animals with penicillin-susceptible organisms could be prevented or cured by penicillin aerosol, and (2) that penicillin aerosol could be applied to many clinical entities without damage to the patients.

In addition, evidence was presented which indicated that penicillin-susceptible organisms would disappear from the sputum of certain types of nontuberculous lung infections.

Other papers which appeared in 1945 have shown that penicillin aerosol therapy, as initiated and organized by the Technical Division, its coordinating agencies, and collaborating groups, has become a standard and useful feature in medicine. While there is some controversy as far as technique and dosage are concerned, the outstanding fact is that it is now widely applied, especially in hospital practice to control suppurative diseases of the lungs of all types. It is also being applied in addition to other antibiotics, such as streptomycin (*8*) and hydrogen peroxide (*2*), in an attempt to improve the pathological processes due to the primary and secondary infections of tuberculosis.

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7. Olsen, A. M. *Proc. staff Meet., Mayo Clin.,* 1945, **20**, 184.
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Scanning Science—

Invitations have been sent for the opening of the new halls of ethnology and vertebrate paleontology of the American Museum of Natural History, New York. The reception will be held from two to three o'clock on November 30.

At midnight on November 15th the electric power generated at Niagara Falls was transmitted to Buffalo where it will be used to operate the trolley cars of the street railway.

—*27 November 1896*

Obituary

Francis William Bergstrom

1897-1946

Francis William Bergstrom, professor of chemistry, died, following a brief illness, in the Stanford University Hospital on 29 March 1946.

Born in Bloomington, Indiana, on 10 January 1897, he went to Stanford with his parents in 1908, when his father was appointed professor of educational psychology at the University. He attended the Palo Alto schools and entered Stanford University as a student in 1914, specializing in chemistry and allied engineering subjects. Receiving the A.B. degree in 1918, he continued with graduate studies under the inspiration and guidance of the late Prof. E. C. Franklin. As a result of this work he was awarded the Ch.E. degree in 1919 and the Ph.D. in 1922. Then followed three years of postdoctorate studies with the aid of a National Research Council Fellowship in chemistry. This period was spent mainly at Clark and Brown Universities, where the young Dr. Bergstrom collaborated with Prof. Charles A. Kraus, who in turn had been one of Prof. Franklin's first students at the University of Kansas.

In 1925 Dr. Bergstrom was appointed instructor in the Chemistry Department of Stanford University. In due course of time he passed through the ranks of assistant and associate professor and in 1942 became a full professor. He was thus directly connected with the Stanford Chemistry Department as a student or faculty member for a total of 29 years. During 1934 he was honored by a Guggenheim Fellowship award for study in Europe, and on this basis he spent about eight months abroad, mainly at Oxford and Heidelberg.

Throughout his career Dr. Bergstrom was a most enthusiastic and industrious scientific investigator. He worked especially with nitrogen compounds, both of the inorganic and organic types. His numerous researches were characterized by great experimental skill and by clear and logical thinking. Approximately 70 scientific papers, published in the most important chemical journals, attest to his outstanding research abilities. Largely as a result of these accomplishments he was appointed as an associate editor of the *Journal of Organic Chemistry* when this publication was started in 1936 and continued in this capacity until his death. During the period 1 July 1943–1 January 1946 he also served as the responsible investigator and supervisor of an important project on antimalarial compounds, sponsored by the Committee on Medical Research, OSRD.

Outstanding as his achievements as a scientist were, it is as a pre-eminent teacher that Prof. Bergstrom will be especially remembered by his colleagues, by the hundreds of undergraduates that passed through his introductory courses in organic chemistry during more than two decades, and by the scores of graduate students who gained knowledge and inspiration for chemical research under his guidance.

GEORGE S. PARKS

Stanford University, California

William Crowell Bray

1879-1946

William Crowell Bray, professor of chemistry at the University of California, died on 24 February 1946.

A native of Wingham, Ontario, Canada, he was a graduate of the University of Toronto and in 1905 took his doctorate at the University of Leipzig, Germany. After five years on the faculty of Massachusetts Institute of Technology, he became assistant professor of chemistry at the University of California in 1912, attaining the professorship in 1918.

During World War I he directed research at the Experimental Station, American University, Washington, D. C., and in 1919 was associate director of the Fixed Nitrogen Research Laboratory. The following year he returned to the University of California.

Prof. Bray was a member of the National Academy of Sciences, the American Chemical Society, the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Electrochemical Society. Among his many outstanding scientific contributions the following are particularly noteworthy: "The general relation between concentration and the conductance of ionized solutions," with C. A. Kraus; "Manganese dioxide as a catalyst for the oxidation of carbon monoxide"; "A system of qualitative analysis for the common elements," with A. A. Noyes; and a series of papers dealing with the mechanism of oxidation-reduction reactions involving hydrogen peroxide, iodine, bromine, and hydrazine. He was the author of *Qualitative analysis for the rare elements,* with A. A. Noyes, and *A course in general chemistry,* with W. M. Latimer.

An able scientist and an inspiring teacher, Prof. Bray has exerted a profound influence on research and teaching in the field of inorganic chemistry.

WENDELL M. LATIMER

University of California, Berkeley

Technical Papers

Lack of Influence of Thiosulfate and Metabisulfite on the Antibiotic Activity of Penicillin

CLIFFORD S. LEONARD

College of Medicine, University of Vermont

Geiger and Conn (*5*) have reported that clavacin, an antibiotic containing an unsaturated ketone group, is inactivated 97 per cent or more by sodium thiosulfate as well as by cysteine and thioglycollate. Penicillic acid, also an unsaturated ketone, was not affected by thiosulfate but was inactivated by the thiols. Reiner and Leonard (*9*) found that p-benzoquinone, which is highly toxic to trypanosomes, was detoxified by sodium thiosulfate and by sodium metabisulfite. Arsenoxides were not detoxified by sodium thiosulfate.

Penicillin does not affect the course of *Trypanosoma equiperdum* infection in the rat,[1] yet oxophenarsine dramatically arrests such infection (*10*).

It seemed of interest to observe whether penicillin, whose structure may contain two ketone groups, or a keto and an incipient azlactone structure (*4*), would be inactivated by sodium thiosulfate and by sodium metabisulfite.[2] It has been shown by Cavallito and co-workers (*1, 2*) and by Chow and McKee (*3*) that penicillin is inactivated by cysteine and certain other thiols, and the view has been advanced that penicillin attacks essential SH enzymes of microorganisms affected by it. If this action thus resembles the action of arsenicals postulated by Voegtlin, Dyer, and Leonard (*10*) and strongly supported by the work of Peters and his co-workers (*7*), it is difficult to see why a host toxicity similar to that of the arsenicals is not displayed by penicillin even in massive doses. Penicillin is, however, reported by Walker, *et al.* (*11*) to exert a toxic action when applied to the cerebral cortex of man and mammals. Early reports on penicillin toxicity are difficult to evaluate because of the impurity of the preparations employed.

Experimental Procedure

Cup tests were made using a standard strain of *Staph. aureus* #209 as the test organism on nutrient agar at pH 7.[3] Pure sodium penicillin (Merck) was dissolved in sterile normal saline to make a dilution of 3 units/cc. and mixed 1:1 with various dilutions of sodium thiosulfate (Merck reagent) and of sodium metabisulfite (C.P., Baker). After standing at room temperature for one hour the mixtures were filled into the cups, 0.3 cc. each, hence .5 unit or 0.3 μg. of penicillin per cup. Control plates consisted of (1) a plate with various dilutions of penicillin and normal saline, (2) a plate of the dilutions of sodium thiosulfate alone in saline, and (3) a plate of the various dilutions of sodium metabisulfite alone in saline. The dilutions of the tested substances were 1:200, 1:2,000, and 1:20,000; hence the cups contained 3 mg., 0.3 mg., and 0.03 mg. of these sulfur compounds, respectively. After 18 hours incubation at 37° C. the zones of inhibition were measured (Table 1).

TABLE 1

DIAMETER OF ZONES OF INHIBITION

	Penicillin Controls			
Units per cup	1	.5	0.1	0.01
Diameter (mm.)	20	15	10	8

	Dilutions of the Tested Sulfur Compound		
	1:200	1:2,000	1:20,000
Sodium thiosulfate alone (A)	..	..	..
Sodium metabisulfite alone (B)	..	..	..
Penicillin + A .5 unit	15 mm.	15 mm.	15 mm.
Penicillin + B .5 unit	15 mm.	15 mm.	15 mm.

Results

At all concentrations tested sodium thiosulfate exerted no inhibitory action on *Staph. aureus*. Sodium metabisulfite likewise displayed no inhibitory action. Penicillin activity was not decreased by either compound.

Discussion

Unlike clavacin and p-benzoquinone, penicillin is not inhibited in antibiotic activity by thiosulfate. Unlike p-benzoquinone, it is not inhibited by metabisulfite. In the inhibition of quinone by these reducing agents the present author held the view that this was simply an *in vitro* reduction of the quinone to the less toxic hydroquinone. Cavallito and co-workers (*2*) admit, in the case of the action of thiols on pyocyanine, that this is an *in vitro* reduction of the antibiotic, for here the colored pyocyanine is decolorized by the thiol.

[1] Unpublished experiments of the author.

[2] Penicillin contains a thiazolidine ring. The antibiotic activity is not inherent in this structure, for other thiazolidines do not display antibiotic activity. We have tested by cup test, diethylrhodanine (5-diethyl-2-thioketo-4-thiazolidine) at various concentrations against *Staphylococcus aureus* and *Escherichia coli*. There was no zone of inhibition of either organism. The diethylrhodanine was prepared by the method of Leonard (*Meddelanden fran K. Vetensk. Nobelinst.*, 1921, 4, No. 14).

[3] I desire to thank C. Grubaugh, of our Bacteriology Department, for aid in these cup tests.

Is the action of the thiols on ketonic antibiotics a simple *in vitro* reduction of the active keto- and lactone groups, thus inactivating the antibiotic? *In vivo* thiols of the host do not appear to inactivate penicillin. Does this necessarily mean that the attack upon the microorganisms is an attack upon specific sulfhydryl enzymes of the parasite affected, while there is little or no attack by some of the antibiotics, such as penicillin, on the essential SH enzymes of the mammalian host or of trypanosomes? Low concentrations of sodium thioglycollate accelerate the action of penicillinase to inhibit penicillin action (*12*). The rapid urinary and biliary excretion of unaltered penicillin would indicate little or no cumulative binding of it by host cells (*8*), such as occurs with arsenicals. The inactivation of penicillin by cysteine has been shown by Hirsh and O'Neil (*6*) to take place only in saline or on agar and not in the presence of broth or serum.

The writer suggests that until it can be proven that penicillin binds to the SH groups of reduced bacterial protein, in proportion to the number of SH groups in such protein, after the manner in which Peters' colleagues showed that As does so bind to kerateine (the reduction product of keratin), the actual point of attack of penicillin on microorganisms cannot definitely be concluded to be upon the thiols of the organism. The inactivating, reducing agents may be simply reducing the antibiotics to inactive substances *in vitro* rather than removing them from combination with thiols of the microorganisms. The lack of host toxicity of penicillin (except at high concentration on brain cells) leads one to consider it possible that its attack may be upon an essential enzymatic process of bacteria and spirochetes, which is not essential to the mammal or the trypanosome. Is this necessarily an "SH" enzyme?

It would be interesting to know the oxidation-reduction potentials of penicillin and clavacin and their position with respect to the oxidation-reduction potentials of the cystine-cysteine system and other oxidative enzyme systems of the organism. Perhaps some of the ketonic antibiotics are at an E_h level such that they can be reduced by both thiosulfate and thiols, while others are at a level requiring the reduction potentials of certain thiols to cause their reduction.

Apparently the ketonic antibiotics can be classified in two groups: (1) those which are inactivated by thiosulfate as well as by thiols, as are clavacin and p-benzoquinone, and (2) those unaffected by thiosulfate but inactivated by certain thiols, as are penicillin and penicillic acid.

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Protective Action of Desoxycorticosterone Acetate Against X-Ray-induced Liver Changes[1]

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X-ray and radium radiations, besides producing local effects, cause a general intoxication clinically known as "radiation sickness." This intoxication is one of the limiting factors in the successful radiological treatment of cancers, especially if the irradiation of larger volumina of the body is required. Many efforts have been made to control this condition, but "the list of remedies recommended for X-ray sickness is noteworthy more for its length than for any benefit that it has provided for sufferers from this distressing complaint" (*7*). This is largely due to the fact that no objective method for the evaluation of these therapeuticals has so far been available.

Data obtained during our previous "lethal dose studies with X-rays" (*2*) and especially some observations concerning fatty changes in the livers made during these investigations (*3*) seem to offer possibilities of a more objective approach to this problem.

Furthermore, the accumulated evidence indicates that histamine-like substances, if not histamine itself, cause the symptoms of radiation sickness (*1*) and also the above-mentioned liver changes (*3*).

On the basis of the histamine theory of radiation effects (*1*), desoxycorticosterone acetate has been chosen in the present study for the evaluation of its usefulness as a remedy for radiation sickness. This sterone is known to counteract histamine effects (*4–6*) and has also been recommended for the treatment of radiation sickness (*8*).

[1] Aided by grants from the John and Mary R. Markle Foundation, New York, and the Schering Corporation, Bloomfield, New Jersey.

Methods: Total body irradiation with X-rays was given to white male mice. The doses were 500 and 1,000 r/air in one exposure or in fractions of 100 r daily. The radiation factors were: 200 kv., 10 Ma., 0.25 mm. Cu + 1.0 mm. Al filters, 50-cm. distance, 20 × 20 cm. field, 23.4 r/minute, HVL = 0.75 mm. Cu. The technic of exposure was the same as previously described (*2*).

Daily doses of 0.25 or 0.5 mg. desoxycorticosterone acetate[2] (in oil) were administered subcutaneously six times weekly. Total doses varying between 2.5 and 8.0 mg. were given within 10 to 18 days. The effects on mortality rate, fat content of the liver, and radiation changes in other organs were studied over a period of 40 days.

TABLE 1

Irradiated animals M = 1.43 σ = 1.42						
	Grading of fat					
X-ray dose	0	+	++	+++	++++	No. of animals
500 r	14	–	8	9	–	31
500 r frac.	8	1	2	5	3	19
1,000 r	11	1	3	3	1	19
1,000 r frac.	7	2	4	6	1	20
Total	40	4	17	23	5	89
Irradiated and desoxycorticosterone-treated animals M = 0.50 σ = 1.01						
	Grading of fat					
X-ray dose	0	+	++	+++	++++	No. of animals
500 r	21	1	3	3	–	28
500 r frac.	14	2	1	2	2	21
1,000 r	13	2	1	–	–	16
1,000 r frac.	13	–	1	–	–	14
Total	61	5	6	5	2	79

M = arithmetical mean = fat index; σ = standard deviation.

Microscopic sections of livers stained with Sudan III were used for the assay of fat, and the following grading was applied: 0 = no sudanophile fat; + = traces of sudanophile fat; ++ = increased amount of fat with definite arrangement around central vessels; +++ = considerable increase in fat; ++++ = fat making up an entire lobule. For the quantitative evaluation of these histological changes the "fat index," *i.e.* the arithmetical mean of the various grades of sudanophile fat, was used.

Results: The outstanding observation made in these studies was a striking reduction in the amount of sudanophile fat in the irradiated and desoxycorticosterone-treated group of animals as compared with those receiving irradiation only. The data are summarized in Table 1.

No striking difference in the radiation effects on bone marrow and spleen was noticed between the irradiated and desoxycorticosterone-treated group and the solely irradiated controls.

However, there was a slight decrease in the mortality rate produced by the various doses of X-rays in favor of the desoxycorticosterone-treated group.

Further details will be given in a later publication.

The protective action of desoxycorticosterone against X-ray-induced liver changes seems to be of interest from various points of view: (1) These results give experimental evaluation to, and support the clinical impression of, the value of desoxycorticosterone in the treatment of radiation illness. They also seem to support the histamine hypothesis of radiation effect. (2) The protective power of desoxycorticosterone against radiation effects in the liver appears of particular interest in the clinical application of radioactive substances known to be selectively deposited in the liver. In utilizing this effect the clinical efficiency of radioactive substances in the treatment of leukemias and cancers may be improved.

[2] We wish to express our gratitude to Dr. E. Henderson, of the Schering Corporation, for generously supplying us with desoxycorticosterone acetate.

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Redox Potentials and Photoreduction by Chloroplast Granules

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The over-all reaction for photosynthesis,

$$CO_2 + HOH \xrightarrow[\text{pigment-system}]{\text{Light}} (CH_2O) + O_2, \qquad (1)$$

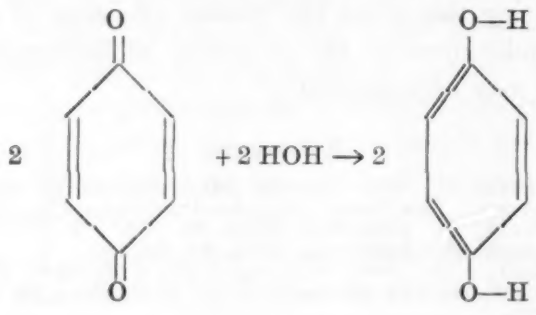
is remarkable not so much for the apparent decomposition of water but for the ability of the system to utilize efficiently as poor an oxidant as CO_2. Light may be used to effect the decomposition of water by inorganic sensitizers, e.g. Hg, if the wave length is sufficiently short. Redox couples (as $Co^{+3} \rightarrow^{+2}$, $Ce^{+4} \rightarrow^{+3}$) with a favorable potential (E° greater than -1.23 volt) are able to oxidize water in the dark. The potential of CO_2—HCHO (formaldehyde) is $+0.08$ (*8*) and probably any "first product" of photosynthesis is of the order of $+0.1$ volt; that of $Fe^{+3} \rightarrow^{+2}$ is -0.771.

[1] Present address: Radiation Laboratory, University of California, Berkeley.

It has long been known (*2*) that disintegrated leaves or isolated chloroplasts have lost the largest part (*4*) of their ability to assimilate CO_2 and evolve O_2. However, Hill (*5*) was able to show that, in the presence of ferric oxalate, isolated chloroplasts evolve oxygen in considerable amounts (measured at first spectrocolorimetrically via $Hb + O_2 \rightarrow HbO_2$, and later manometrically) according to the reaction,

$$4\ Fe^{+3} + 2\ HOH \rightarrow 4\ Fe^{+2} + 4\ H^{+} + O_2, \qquad (2)$$

which, of course, bears some analogy to that of photosynthesis. Further validation of the course of the reaction as following Equation (2) is afforded by recent work of Holt and French (*6*), where the reaction is followed titrimetrically (*i.e.* for H^+). The analogy to photosynthesis was even more evident when Warburg and Lüttgens (*9*) showed that chloroplasts were able to use o-benzoquinone as the oxidant, viz.,



(3)

since the oxidant here is actually the hydrogen acceptor.[2] These authors point out that chloroplast granules were also able to give the reaction.

The similarity of Equations (2) and (3) suggests that a certain generality exists in the ability of the chlorophyll system to effect the decomposition of water with the aid of oxidants and light. We have added to this generality by showing that various types of quinones are able to serve as oxidants. The rates of evolution of oxygen with the various quinones are, however, a function of their redox potentials (Fig. 1). One might have expected that if the photochemical reaction could proceed at all, then it should proceed independently of the potential. That the reaction is potential dependent appears to indicate that under these circumstances this system is not as capable of preventing those back reactions which, in normal photosynthesis, permit as poor an oxidant as CO_2 to be used to dissociate water.

One should not construe from linear extrapolation of the data that oxidants with a couple lower than -0.05 are incapable of giving the reaction. The values given in the figure are maximal, and deviation from linearity of the benzoquinone (as compared with the naphthaquinones) may be due to the greater number of runs available for the former rather than actuality. The necessity for this manner of presentation arises from the relatively rapid inactivation of the material, both Hill and Kumm and French (*7*) having noted a half-life of about two hours. In agreement with these authors we also found that different preparations (in our case, of market spinach) gave variable results. Material left overnight invariably lost almost 90 per cent of its activity (with no accompanying spectroscopic change), and such granules were often incapable of yielding oxygen with anthraquinone sulfonate. It is thus possible that the material, at the moment of isolation, is capable of utilizing oxidants even in the plus-voltage range, but because of the length of time in preparation (about two hours) sufficient deterioration has occurred to prevent its experimental verification.

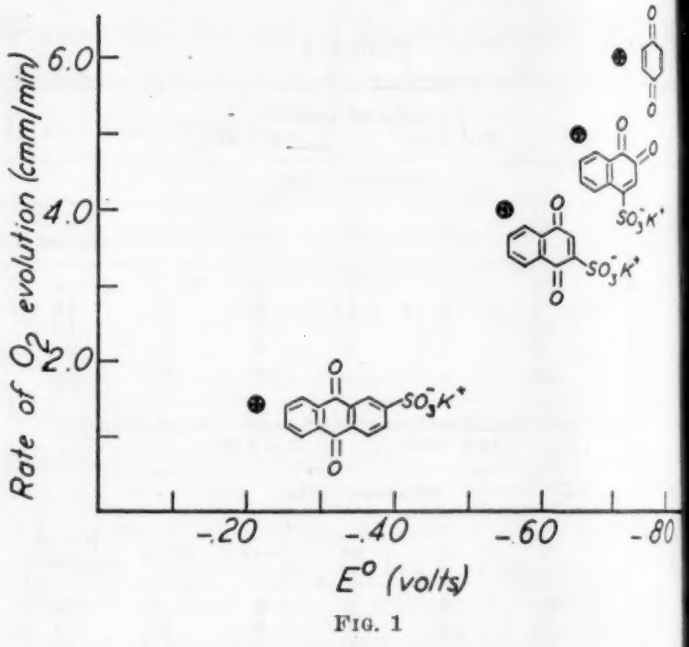


FIG. 1

Experimental details and other pertinent data will be discussed in a later publication.

Addendum. Additional work has shown that the rates of oxygen liberation by the various quinones are not equally proportional to the light intensity. With decreasing flux the poorer oxidants become relatively more efficient, until at one-third the intensity used above (30,000 lux) the rates are actually reversed. Furthermore, at the maximal flux, practical saturation has been reached, the rate leveling off more rapidly the poorer the oxidant.

[2] One must note the experiments of Fan, *et al.* (*3*), who presented evidence that benzaldehyde, acetaldehyde, and nitrourea may be reduced by algae, in the absence of external CO_2, with the evolution of oxygen. The effects mentioned therein are but slightly greater than those of respiration and therefore not as conclusive as the above-mentioned experiments. Furthermore, Boichenko (*1*) has noted not only evolution of oxygen (detected by oxidation of leuco dyes) but assimilation of CO_2 (as noted by change in pH of medium) by chloroplasts. We have as yet been unable to duplicate these results manometrically, possibly due to insufficient experimental details.

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Direct Observation of the Transfer of Pronuclei in Living Conjugants of *Paramecium bursaria*[1]

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At the present time three sexual processes have been described for *Paramecium* in which three micronuclear (pregamic) divisions lead to synkaryon formation. In one, called conjugation (cross-fertilization), there is a temporary union of two individuals involving three micronuclear divisions, *nuclear exchange,* and the establishment of a new synkaryon in each conjugant. Thus, a sine qua non of conjugation is nuclear exchange. The second process, called autogamy (self-fertilization), was described by Diller (*2*) for *P. aurelia* as occurring in *single* animals only. Here, three micronuclear divisions lead to the formation of gametic nuclei which fuse and form a synkaryon in the single animal without the cooperation of another individual.

Earlier investigators used killed and stained paramecia for their cytological studies. Beginning in 1936 the author approached the problem of cytological study of nuclear behavior in joined paramecia with an entirely new method. Studies were made on *living* joined pairs of paramecia which were isolated and placed in a precision microcompression chamber so that direct observations could be made under the microscope. This method led to the discovery of a third and new sexual process called *cytogamy.* In this process, the three pregamic divisions occur as in conjugation, but, instead of a transfer of pronuclei as in true conjugation, the pronuclei remain within the confines of each joined individual and a synkaryon is formed in each (*8*). The classical accounts of conjugation wherein nuclear exchange is supposed to be a constant feature were questioned.

More recently, a rather lively interest has developed in the problems of exchange of pronuclei and cytoplasm during the conjugation process. On the general problem papers have appeared giving cytologic, genetic, and serologic evidence of the transfer of pronuclei or cytoplasm or both during conjugation. Chen (*1*), using fixed and stained preparations of *P. bursaria* presents cytological evidence of pronuclear transfer. In addition, he reports some cases in which the two pronuclei remain in the same conjugant and fuse to form a synkaryon (cytogamy). Sonneborn (*7*) presents genetic evidence to show that there is nuclear and cytoplasmic transfer in *P. aurelia* during conjugation, and he also shows genetic evidence for cytogamy. He reports that the transfer of cytoplasm is crudely measured by the extent of the time interval between separation of conjugants at their anterior ends and separation at their paroral cones. If the interval is less than 3½ minutes, exchange of cytoplasm is not detected, regardless of what races were crossed, but when the interval is 20 minutes or more, "cytoplasmic factor" is invariably transferred. Further, he reports that exchange of cytoplasm at conjugation never occurs in crosses in certain races (although nuclei are exchanged in these crosses) but does occur in others. Concerning nuclear exchange, Sonneborn (*6*) reported that there is a definite temperature factor involved in cross-fertilization and some indication that calcium increases the frequency of it and that sodium decreases it. Harrison and Fowler (*4*) present serologic evidence of cytoplasmic interchange during conjugation of *P. bursaria.* They believe that the antigen involved in the reaction is very largely, if not exclusively, cytoplasmic in character and that there is an extensive interchange of cytoplasm.

In view of what has been done thus far, it was thought desirable to study the conjugation process in the *living* condition in an effort to obtain information on nuclear and cytoplasmic behavior and determine the time relationships involved. From a large number of races of five different species of *Paramecium,* two races of *P. bursaria,* of opposite mating type, seemed pre-eminently suited for direct observation on living conjugants when placed in the microcompression chamber. One race, B9, is composed of large green specimens due to the presence of zoochlorellae, while the other race, 255 (kindly supplied by Dr. J. A. Harrison), consists of smaller paramecia which are colorless because of the complete absence of zoochlorellae. At any time or in any stage one is able to identify the members of each race in the conjugation process. The mating reaction is much like that reported for this species by Jennings (*5*). Here the organisms begin showing a feeble mating reaction at 4:45 A.M. at 25° C., concomitant with the appearance of daylight. The reaction gradually increases in intensity until at 8:00 A.M. it is strong

[1] Aided by a grant from the Committee on Research and Publication, Temple University.

and continues so through the noon hour. The intensity of the reaction gradually decreases after 1:30 P.M., becoming feeble again at approximately 4:30 P.M. For this study, single joined pairs were isolated as soon as formed and then placed in the microcompression chamber for observation.

In conjugation the three pregamic divisions occur as follows at 25° C.: completion of first division, approximately 14 hours after mating; completion of second division, an hour after the first; the third division, involving exchange of pronuclei and syngamy, 16–18 hours after mating. One can see that the micronuclear product, which remains near the paroral region after the first and second divisions, generally is the one destined to undergo a succeeding division. The one farthest from that region degenerates. The dividing spindle of the third pregamic division is seen to arrange itself at nearly right angles to the long axis of the conjugant and press against the membrane at the point of crossing. It takes about 20 minutes for the migratory pole of the spindle to pass from one conjugant to the other. Cyclosis in each conjugant is slower than usual, and crystals are seen to bunch themselves around the dividing spindles.

After syngamy, the three amphinuclear (metagamic) divisions are completed, respectively, as follows: the first, approximately 20 hours after mating; the second, 22 hours; and the third, 24 hours. Conjugants frequently are seen completing the third amphinuclear division at the time of separation 24 hours after mating. All of the time relationships given here were recorded at a temperature of 25° C. and differ widely from those of Hamburger (*3*). Temperature is an important factor regarding the length of time the animals remain joined together in the process.

It is noteworthy that in no case was a visible transfer of cytoplasm or of zoochlorellae observed during the conjugation of these mating types.

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News and Notes

The recently organized Emergency Committee of Atomic Scientists of which Albert Einstein is president and Harold C. Urey is vice president, met on 17 November in Princeton, New Jersey, to devise means of raising a $1,000,000 educational fund to aid in enlightening the public on the social implications of nuclear energy. The Committee has announced six objectives of the educational campaign and various members of the committee and others are available to speak on these points in various parts of the country.

The six statements of fact follow:

1) Atomic bombs can now be made cheaply and in large number. They will become more destructive.

2) There is no military defense against atomic bombs and none is to be expected.

3) Other nations can rediscover our secret processes by themselves.

4) Preparedness against atomic war is futile, and if attempted, will ruin the structure of our social order.

5) If war breaks out, atomic bombs will be used, and they will surely destroy our civilization.

6) There is no solution to this problem except international control of atomic energy and ultimately, the elimination of war.

Aside from Prof. Einstein and Dr. Urey, the other members of the Committee are: Selig Hecht, Columbia University; Victor F. Weisskopf, Massachusetts Institute of Technology; Leo S. Szilard, University of Chicago; Hans A. Bethe, Cornell University; Thorfin R. Hogness, University of Chicago; Philip M. Morse, on leave from Massachusetts Institute of Technology; and Linus Pauling, University of California.

A Committee on a Junior Scientists' Assembly, with Morris Meister, president of the National Association of Science Teachers, as chairman, has recently been appointed by the AAAS. This Committee is working to bring together young scientists who are still in the midst of their scientific training, so that they may share their experiences and opinions. The Assembly of Junior Scientists was planned in realization of the increasing importance of the role of young scientists. Many young persons during the war were taken directly from their studies and placed on important research teams where they assumed great responsibility. Most of these young men and women have now returned to school and are in a position to look back at their recent secondary studies and evaluate them for teachers and for science-minded high school pupils. They are also looking ahead toward

their work as scientists in a period of unparalleled technological advancement.

The theme for the first meeting of the Junior Scientists' Assembly is: "The Young Scientist Looks at Education and at His Work." This meeting will be held at 2:30 P.M. on 27 December, in the Lobby Ballroom of the Bradford Hotel, Boston. Those invited to participate in the panel discussion include winners of the Science Talent Search, honorary members of the AAAS from the Junior Academies of Sciences, former members of science clubs, and individuals whose initial progress in scientific work has been outstanding.

Special effort is being made to call the attention of science teachers and all scientists to the first Junior Scientists' Assembly. The Committee plans to make this Assembly a special feature of AAAS meetings, and it is interested in the cooperation of members of the Association who feel that it is their concern to guide the future of youth in science.

About People

Clifford C. Volkerding has been named associate soil scientist and assistant dean of agriculture at the North Dakota Agricultural College, Fargo. Dr. Volkerding was formerly employed by the Du Pont Company.

Lester R. Aronson, assistant curator, Department of Animal Behavior, American Museum of Natural History, has been appointed acting chairman and associate curator of the Department. Dr. Aronson succeeds Frank A. Beach, who received an appointment as professor of psychology at Yale University.

C. H. Connell, recently a lieutenant colonel in the Sanitary Corps, AUS, is now with the Department of Preventive Medicine and Public Health, University of Texas Medical Branch, Galveston. Dr. Connell was connected with the Department of Municipal and Sanitary Engineering, A. and M. College of Texas, as associate professor prior to his military activity.

Vernon D. Tate, director of the Division of Photographic Archives and Research of the National Archives, Washington, has been appointed librarian of the Massachusetts Institute of Technology, John E. Burchard, director of libraries, announced on 26 October. Dr. Tate will take active charge next July when William N. Seaver, librarian since 1925, retires. Since 1938 Dr. Tate has been editor of the *Journal of Documentary Reproduction.*

E. M. Hildebrand, formerly plant pathologist, Research Department of the Food Machinery Corporation, Dunedin, Florida, has recently joined the staff of Texas A. and M. College as associate professor in the Biology Department.

Arthur H. Compton, chancellor of Washington University, St. Louis, and *W. Albert Noyes,* chairman of the University of Rochester Chemistry Department and president of the American Chemical Society, are attending the first general conference of UNESCO, which opened in Paris on 19 November. Dr. Noyes was appointed by the State Department as scientific adviser, and Dr. Compton is one of the voting delegates.

Visitors From Abroad

Marcel Riesz, of the Lunds Universitets Matematiska Institution, Lund, Sweden, has accepted an invitation as visiting lecturer at the University of Chicago for the winter and spring quarters, 2 January to 13 June 1947. He expects to offer a course on hyperbolic differential equations (wave equations) during the winter quarter. Professor Riesz will also organize a seminar during his term of residence, according to Marshall H. Stone, chairman of the Department of Mathematics.

Sir Lionel Whitby, Regius professor of physic, University of Cambridge, spoke on "Chemotherapy Yesterday and Today" at the Institute of Medicine of Chicago on 18 November.

Paulo Borges, pathological and anatomical laboratory, University of Minas Gerais, Belo Horizante, Brazil, is working at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, under a fellowship from the Institute of International Education.

Announcements

The Lasker Awards for two types of outstanding service in mental hygiene have been conferred on W. Horsley Gantt, Phipps Psychiatric Clinic, Johns Hopkins School of Medicine; Rev. D. R. Sharpe, president of the Ohio Mental Hygiene Association; and Walter Lerch, reporter on the *Cleveland Press.* The presentations were made at the annual luncheon meeting of the National Committee for Mental Hygiene in the Hotel Pennsylvania, New York City, on 31 October.

One award of $500, for experimental investigation into behavior deviation, was presented to Dr. Gantt by James R. Angell, vice-president of the Committee and public service counsellor of the National Broadcasting Company. Jules Masserman, of the Division of Psychiatry, University of Chicago, received honorable mention.

The other award of $500, for efforts to improve hospital care for mental patients, was conferred jointly on Dr. Sharpe and Mr. Lerch by Samuel W. Hamilton, adviser, Mental Hygiene Division, U. S. Public Health Service, and president of the American Psychiatric Association. Albert Deutsch, feature writer on *PM,* received honorable mention.

The Lasker Award of $1,000, established in 1944 by

the Albert and Mary Lasker Foundation, is given annually through the Committee for meritorious service and significant contributions to the promotion of mental health and the increase of public understanding of mental hygiene. Each year the award is made for distinguished service in some special aspect of the field of mental hygiene which is of current significance.

The first award, given in 1944, was for mental hygiene work related to the war. Col. William C. Menninger, chief consultant in neuropsychiatry, Office of The Surgeon General, U. S. Army, received the award for work done to enhance the mental health of men and women of the armed services while in the service and during the period of rehabilitation. In 1945 the award was conferred jointly on John Rawlings Rees, consultant in psychiatry to the Directorate of Psychiatry of the British Army, and Maj. Gen. G. Brock Chisholm, Deputy Minister of National Health, Federal Department of National Health and Welfare, Canada, for outstanding service in rehabilitation.

NRC News

Merck and Company has made an appropriation of $100,000 to the National Research Council to support a new series of fellowships. It is the purpose of these fellowships to give special training and experience to young men and women who have demonstrated marked ability in research in chemical or biological science and wish to broaden their fields of investigational activity.

Qualifications of applicants: The Merck Fellowships are open only to citizens of the United States. Applicants must produce evidence of training in chemistry or biology equivalent to that represented by the degree of Ph.D., and of unusual talent for experimental research.

Fields of study: All fields of chemistry and biology, including the preclinical medical sciences, are open to applicants for Merck Fellowships. Recognizing that many scientific problems in these fields are of such complexity that a thorough grasp of more than one discipline is required for satisfactory approach toward their solution, the Merck Fellowship Board will give special consideration to those applicants who wish to supplement mastery in one field by becoming competent in another. It is hoped that the capacity for deeper understanding thus acquired may result in new knowledge of the identity and character of cellular processes and concerning the action of chemical substances upon them.

Conditions of appointment: The fellowships will be awarded at annual meetings of the Merck Fellowship Board. To receive consideration at the next meeting, *applications must be filed on or before 15 January 1947*. Applicants may subsequently be requested to appear before the Board for personal interview; in such cases, traveling expenses will be provided by the Board. Fellowship appointments are subject to the condition that after they have been accepted by the applicants, neither place nor general program of work shall be changed without the consent of the Board. Unless otherwise arranged tenure will begin on 1 July 1947; the initial appointment will be for a term of one year, renewable for a second and in exceptional cases for a third.

Merck Fellows will be required to devote their entire time to research and advanced courses of study. Six weeks annually will be allowed for vacation.

Grants: The annual stipends, which will be determined in every case by the Merck Fellowship Board, will be in the range of $2,500 to $5,000. An allowance for necessary travel will be available, and an amount of $500 or more will be provided annually to the institution to which each Fellow is assigned.

Location of work: The fellowship awards are made to individuals for study and research in this country or abroad. The institution in which the Fellow works, and the persons under whom he works, shall be approved by the Board. Fellows will be encouraged to undertake their fellowship work in institutions other than those in which their original training was secured.

Reports: From time to time, as the Board may determine, the persons under whose direction a Fellow is working may be asked to report concerning his or her progress. Before retiring, all Fellows will be required to submit to the Board for record a brief report of the principal results of their research and fellowship experience.

Publication: It is understood that results of work carried out by a Fellow shall be available to the public through accepted scientific channels, without restriction. The publication of the results of an investigation made during the tenure of the fellowship should include a statement indicating that the author is a Merck Fellow in the Natural Sciences under the National Research Council. If publications resulting from work under a fellowship appear, the author is expected to furnish ten reprints of each paper to the Chairman of the Merck Fellowship Board of the National Research Council.

Members of the Merck Fellowship Board are: A. N. Richards, chairman, University of Pennsylvania; George W. Beadle, California Institute of Technology; Hans T. Clarke, Columbia University; George O. Curme, Jr., Carbide and Carbon Chemicals Corporation; René J. Dubos, Rockefeller Institute for Medical Research; The Chairman, National Research Council, *ex officio*. Requests for application blanks or for additional information should be addressed to the

Merck Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Fellowships in the Medical Sciences, similar to those which have been administered by the Medical Fellowship Board of the National Research Council since 1922, will again be available for the year 1947–48. These fellowships, supported by grants from The Rockefeller Foundation to the NRC, are designed to provide opportunities for training and experience in research in all branches of medical science. They are open to citizens of the United States or Canada who possess an M.D. or Ph.D. degree, and are intended for recent graduates who are not yet professionally established.

In addition to these fellowships, the Medical Fellowship Board administers two groups of research fellowships, made available through a grant from the National Foundation for Infantile Paralysis, Inc. The first group, open to applicants who hold either the Ph.D. or M.D. degree, is for the purpose of providing opportunities for special training and experience in the study of filtrable viruses. The second group, open only to graduates in medicine who have completed one or more years of hospital experience in clinical surgery and are planning a career in orthopedic surgery, is designed to provide opportunities for training and research in those basic medical sciences which will be of particular value in furthering progress in the field of orthopedic surgery.

A series of fellowships in anesthesiology has been established through a grant from the American Society of Anesthesiologists. These fellowships are offered with a view to fostering a closer union between the clinical practice of anesthesiology and the fundamental disciplines on which anesthesia rests. Applicants must hold the M.D. degree and must have completed one or more years of hospital experience as intern or resident.

The Medical Fellowship Board of the NRC has also under its jurisdiction a number of fellowships of senior grade in internal medicine (Welch Fellowships), virus diseases, orthopedic surgery, and pediatrics, for individuals of proven research ability.

Fellows will be appointed at a meeting of the Medical Fellowship Board early in March 1947. Applications to receive consideration at this meeting must be filed on or before 1 January. Appointments may begin on any date determined by the Board.

For further particulars concerning these fellowships, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Eleven separate agencies at Harvard University have become concerned in instruction, demonstration, or research in the botanical field during the last 70 years. Nine of these agencies were created by endowments designated for specific objectives. To insure adequate furtherance of these objectives and at the same time to attain greater efficiency in integration and in administration from the point of view of the future welfare of botany as a whole, two new administrative and budgetary areas have been created. One of these, designated "Institute for Research in General Plant Morphology," includes the Gray Herbarium and Library, the Farlow Library and Herbarium, the Herbarium and Library of the Arnold Arboretum, and the collections, libraries, and herbaria of the Botanical Museum. It is concerned with research in taxonomy, phytogeography, paleobotany, mycology, comparative anatomy, developmental morphology, and certain aspects of economic botany. A new, centrally located building will be erected in close proximity to the Biological Laboratories to house these at present widely scattered herbaria, libraries, and collections. The second area, designated "Institute for Research in Experimental and Applied Botany," includes the Arnold Arboretum, the Bussey Institution, the Cabot Foundation, the Harvard Forest, and the Atkins Garden and Research Laboratory in Cuba. It is concerned with research in plant genetics, plant physiology, horticulture, silviculture, and various aspects of economic botany. Other activities will develop as funds permit.

To ensure adequate consideration of the future welfare of botany as a whole and its development in relationship to other biological disciplines, the chairmen of the two areal research bodies, the director of the Museum of Comparative Zoology, the chairman of the Department of Biology, and the director of the Biological Laboratories have been constituted as a Biological Council under the chairmanship of the provost of the University. All major deliberations and recommendations regarding botanical, zoological, and other biological matters will be referred to this body.

The reorganization of botanical activities has thus far involved the following administrative appointments: *Institute for Research in General Plant Morphology*—chairman, Irving W. Bailey; vice-chairman, Hugh M. Raup, and ad interim supervisor of the Herbarium and Library of the Arnold Arboretum, Ivan M. Johnston; *Institute for Research in Experimental and Applied Botany*—chairman, Paul C. Mangelsdorf; vice-chairman, Kenneth V. Thimann; ad interim director, Arnold Arboretum, and supervisor, Bussey Institution, Karl Sax; director, Harvard Forest, Hugh M. Raup; and director, Atkins Garden and Research Laboratory, Arthur G. Kevorkian (see *Science,* 1946, **104,** 204). With the retirement of Elmer D. Merrill from administrative responsibilities at the age of 70, the post of administrator of Botanical Collections has been abolished.

In the Laboratory

Design for an Impact Decelerator[1]

HOWARD R. BIERMAN, CDR. (MC), USNR
Naval Medical Research Institute, Bethesda, Maryland

In an attempt to study the characteristics of forces imposed upon the human in an aircraft crash, an apparatus was constructed to deliver a known impact force of a given duration and direction to an individual. At the moment of impact in an aircraft crash the individual in the plane is thrown against the restraining shoulder straps and seat belt. A similar

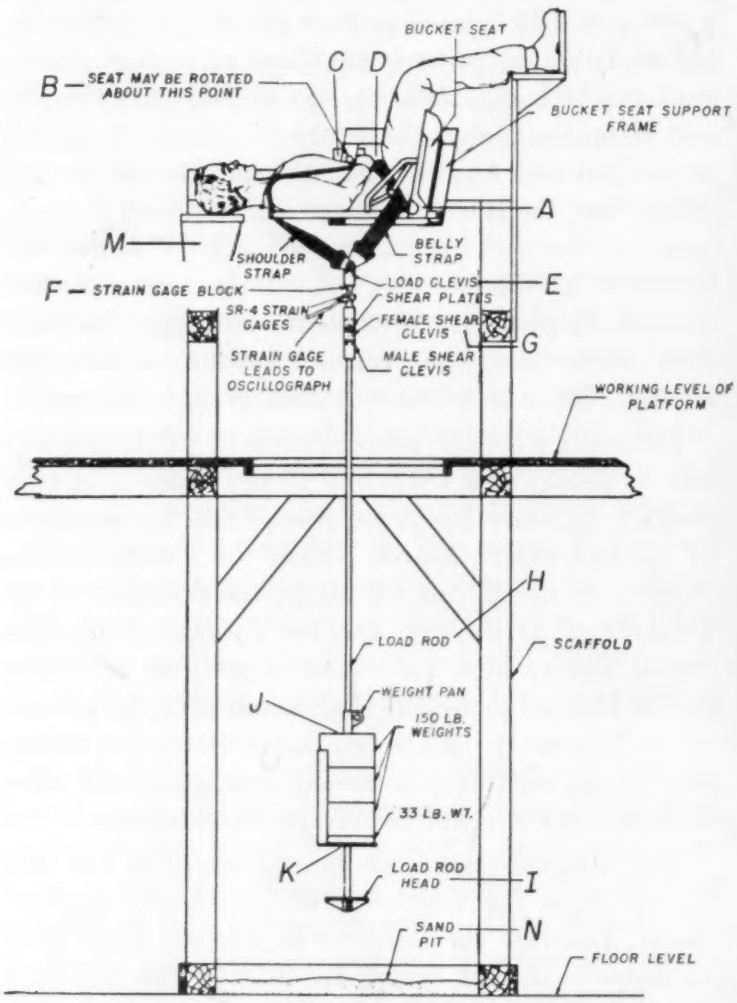

FIG. 1. Crash injury investigation setup, No. 1 series

effect can be obtained if the individual is held in a seat by shoulder straps and seat belt and, at a given time, these are suddenly jerked back against the body. The magnitude and duration of the force allow an estimate to be made of the acceleration of the restraining harness which that force produces. This impact force is transmitted to the individual through the harness.

APPARATUS

The apparatus consists of a scaffold arrangement upon which an aircraft seat is mounted horizontally (Fig. 1, A). The seat support is so constructed that it may be rotated about the center of gravity of the individual on the seat (B). The seat may be fixed in any given position by four set screws (C; see also Fig. 2) and by a long lever arm from the fulcrum to a cross bar. Regular pilot seats in current use may be mounted on this seat support, and the individual

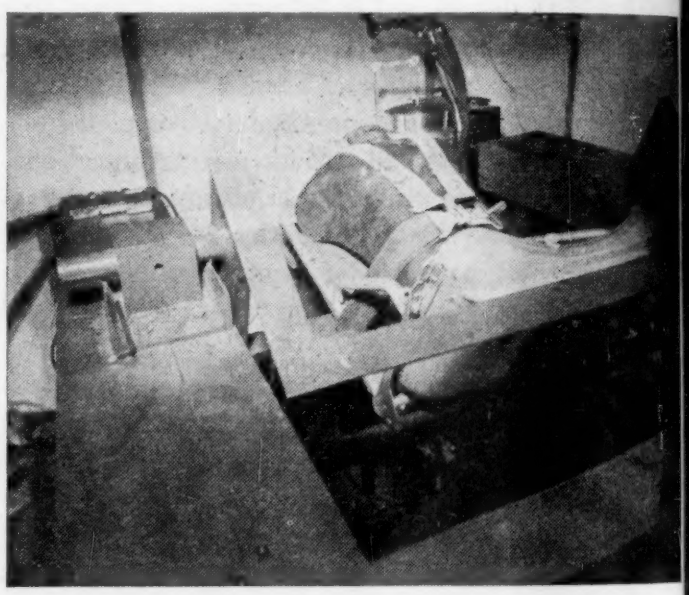

FIG. 2. A three-quarter view of the seat from above and forward; wood dummy secured in seat by shoulder straps and seat belt. The cubic metal block to the left supports the bar which allows longitudinal rotation of the seat. The hole in this block contains one of the four set screws to secure the seat in desired position.

is strapped in the seat with the regulation type of shoulder harness and lap safety belt (Fig. 2). The straps and the belt secure forward to a single quick-release mechanism (D; see also Fig. 2) and are joined behind in a single union at a clevis (E; also Fig. 3). This clevis distributes the weight uniformly to the shoulder straps and the lap safety belt if the length of the straps is adjusted correctly. Below the clevis a steel bar is attached, surrounded by a block gage composed of six SR–4 wire strain gages[2] (F). Immedi-

[1] The apparatus was constructed by the Taylor Model Basin, Carderock, Maryland, through the authority and aid of the following: Capt. H. E. Saunders, USN, technical director; Cdr. G. L. Smith, USN (Ret.); R. T. McGoldrick, S. F. Vane, J. S. Boyle, and L. A. Lofgren. The strain-gage recording elements were developed and kept in operation by L. D. Anderson and J. P. Hendrican. Their help is gratefully acknowledged.

[2] An element consisting of an arrangement of fine wire which is attached to a surface so that compression or tension of that surface will change the resistance and thence the current passing through the wire.

ately below the strain-gage bar is a shear block accommodating shear plates of different thicknesses. Directly below the shear-plate mechanism a 56-inch steel rod (H) is suspended from the male shear clevis, and a fixed arresting plate (load rod head, I) is secured to the bottom of the rod. A pan which supports the weights runs on this rod (J) and may be lifted to various heights along the rod and dropped against the steel arresting plate (Fig. 4). This produces impacts of various magnitudes of given duration. On the bottom of the pan is a circular, ¼-inch-thick, felt pad (K). The head of the subject is usually supported in the horizontal position by a headrest (M), which is separate from the seat. The bottom of the pit is filled wtih sand (N) to catch the rod, arresting plate, and weight as they fall free from the rest of the mechanism after the plate is sheared.

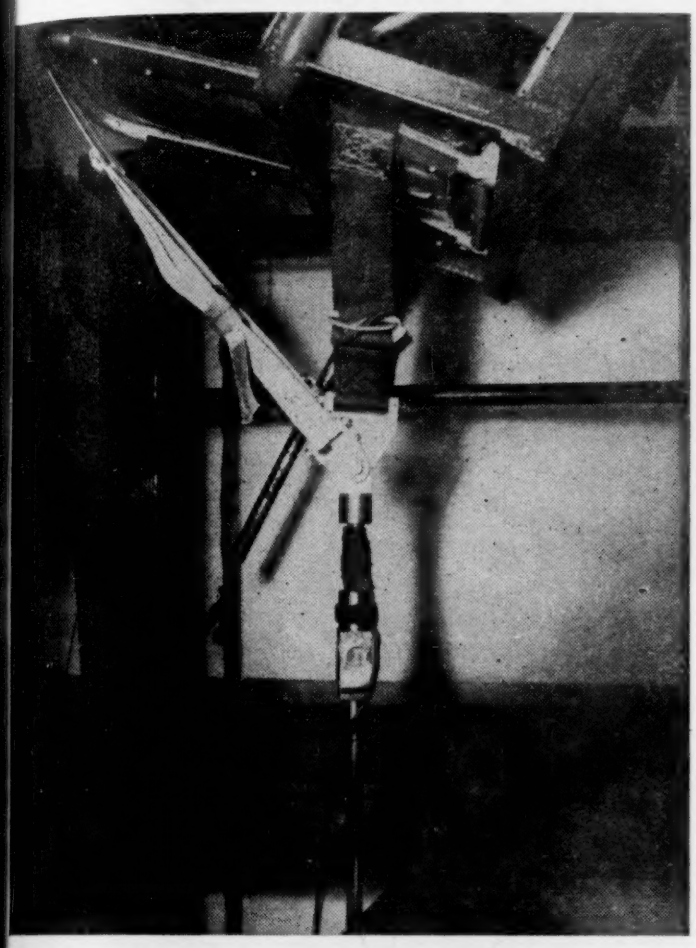

FIG. 3. View below the seat from the side, illustrating the attachment of the shoulder harness and seat belt to the clevis and suspension of shear block and rod. The strain gages are beneath the black tape between the clevis and the shear block. The long cross bar to help fix the seat in position is seen in the background. The headrest for the subject is up and to the left.

OPERATION

The subject is placed in the chair and the strap and shoulder harness adjusted about him in their correct position. A light load is then applied, and the weight allowed to hang on the individual so that he can adjust the shoulder straps and seat belt for comfort. A trained subject soon learns that impact forces

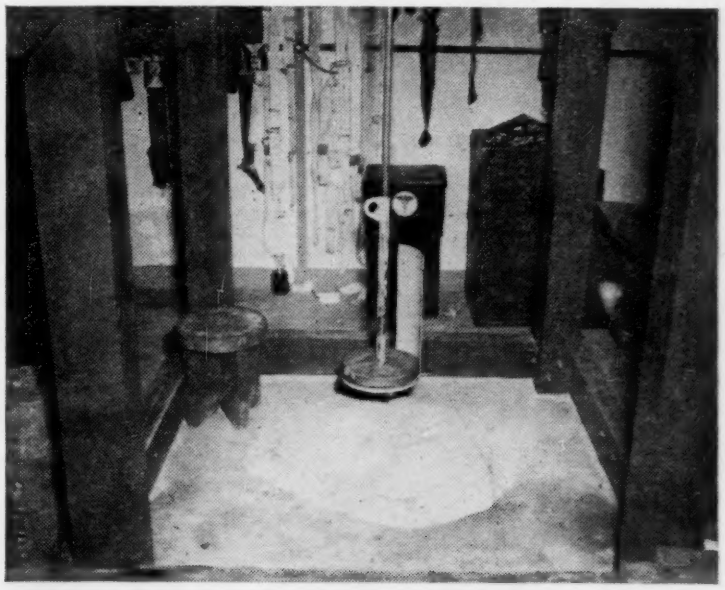

FIG. 4. Lateral view of pan and sand pit. The eye at the top of the pan permits lifting the heavy weights by a pulley system. The stool to the left is used to rest the pan and slack off the weight on the subject between drops.

can be withstood more easily if the force is taken up equally by the shoulder straps and the seat belt. The rod, the arresting plate and the pan (even without weight) should be supported below when a drop is not immediately anticipated. Since this assembly

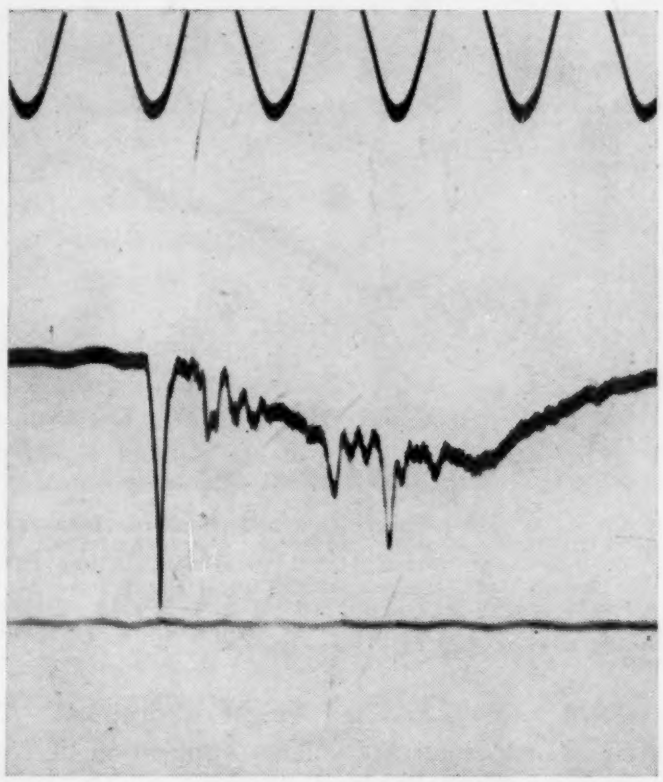

FIG. 5. Recording of the block strain gage. The initial high peak does not indicate forces being applied to the subject. It is probably due to forces set up in the linkage of the metal parts to which the belts and straps attach. The secondary section of the curve represents an impact force upon the subject of 936 pounds. The impact is completed in 70 milliseconds. A 60 cycle second wave is used for timing.

weighs 56 pounds, it will soon tire the individual if he must support it even for short periods. After all recording devices have been standardized and calibrated and the individual is ready for the drop, the rod is swung free of its support and the pan is lifted to its predetermined height, bearing the desired weight. At a given signal the recording apparatus is set in motion, and the weight is dropped. The individual experiences a sudden application of force to his body, transmitted through the shoulder straps and the seat belt.

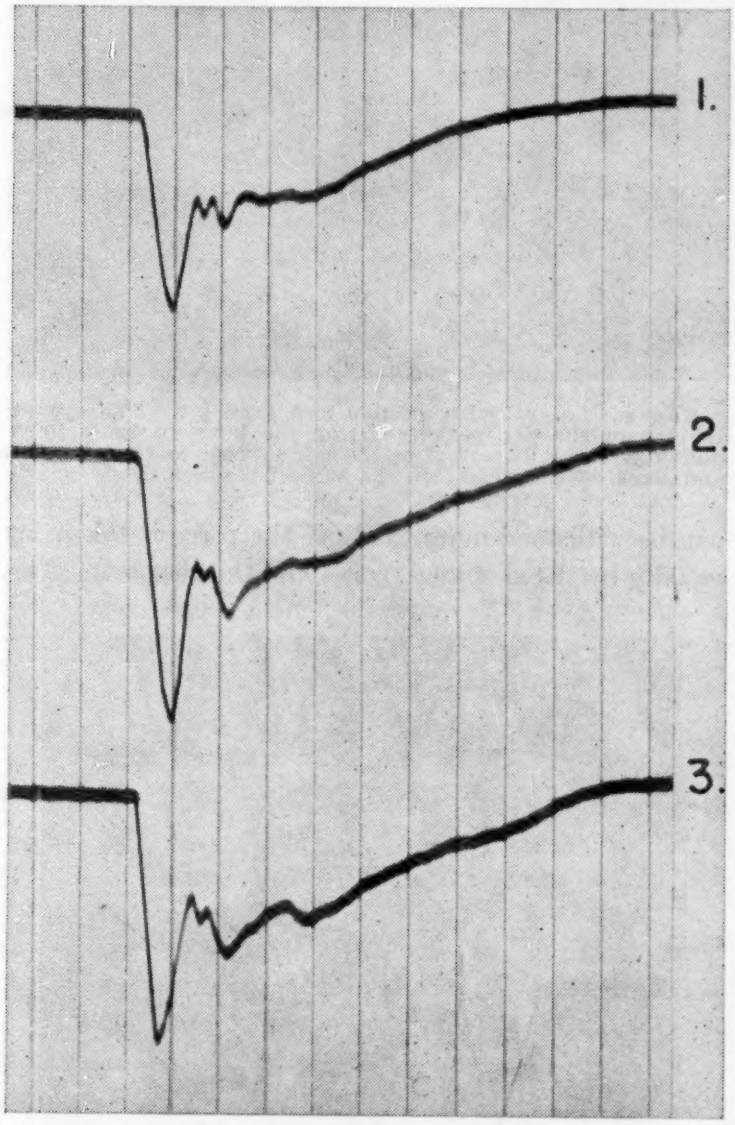

FIG. 6. A simultaneous recording of three beam gages placed in various positions under the shoulder straps. Timing lines indicate intervals of 1/60 second. These curves show both the magnitude and the duration of forces being exerted on the subject upon areas in contact with the gages. The peak force in each case is as follows: (1) 151 pounds, (2) 120 pounds, and (3) 134 pounds.

The impulse detected by the strain-gage mechanism is amplified electrically and recorded with a string galvanometer. The total force applied to the rod is measured by the block gage (Fig. 5). This group of strain gages permits a reliable estimate of the forces delivered and averages the amount of stretch in the steel bar. The force applied to the body at shoulder straps and seat belt may be recorded separately at any point on the belt or strap by inserting beam-type strain gages at the desired location. Examples of these recordings are shown in Fig. 6. The total force and the forces exerted at positions beneath the restraining harness may be recorded simultaneously (Fig. 7).

The seat may be rotated about an axis in the horizontal plane. This permits a simulation of crashes in a nose-down or nose-up position. The shear-plate mechanism serves as a protection against unanticipated large loads being dropped on the subject inadvertently. It also permits the application of a single impact load to the subject without continued oscillation or bouncing. The duration of the impact may be increased by placing various types of soft material such as putty, felt, or rubber on the plate. During the drop of heavy weights from high distances it is wise to have the head supported free and flexibly

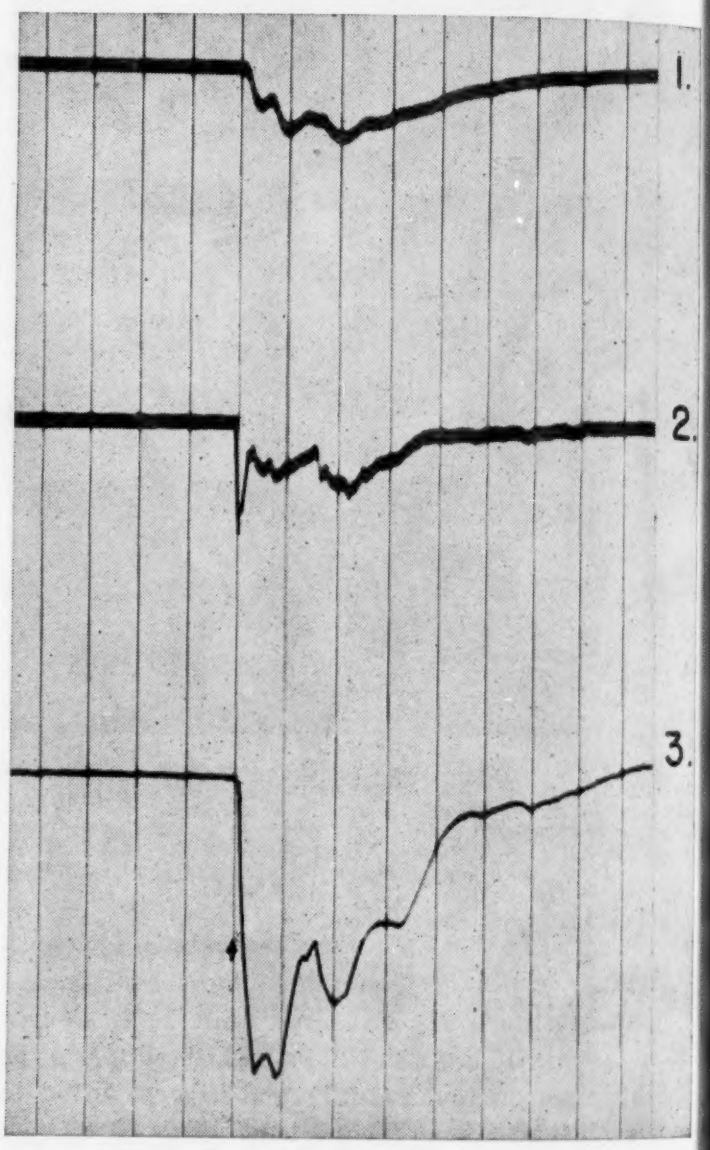

FIG. 7. A simultaneous recording of two beam gages (Curves 1 and 3) and the block gage (Curve 2). The shape of these curves depends upon the position of the strain gage and the type of recording element used. The peak force indicated in each case is as follows: (1) 57 pounds, (2) 713 pounds, and (3) 166 pounds.

because of the large amount of jarring. Frequently the neck will be flexed forward to an extreme position if the head is supported firmly behind.

Limitations of the Impact Decelerator

One serious objection to this apparatus is that the seat belt does not strike the individual in exactly the same area as it may in an aircraft accident. A set of side-arm rollers which are attached to the seat allows the seat belt to simulate more closely its position in the aircraft (Fig. 1). However, in this type of seat the rollers and side arms absorb 60–70 per cent of the applied force, so that the weights which are dropped on the individual must be increased accordingly to obtain the same impact force as is delivered with the original type of seat.

Another objection is that the vascular system of an individual in position in this apparatus may behave quite differently on impact than if he were sitting upright. This influences responses such as blood pressure and pulse rate immediately following impact. The horizontal position also displaces the viscera posteriorly and superiorly. Visceral movement is more restricted during impacts in this device than it would be in an actual aircraft crash. It must be stressed that the straps, and not the individual, are accelerated. This simplifies observations by electronic and photographic devices during the impact.

The trained subject soon learns to brace himself for impact loads and develops his own technic for taking the simulated crashes. Some individuals tense all muscle groups for the impact, while others relax. It is undoubtedly true that some of the force of the impact is absorbed during an actual crash by the legs and thighs extended against the rudder pedals. Such an opportunity is not present in this apparatus.

Addendum. Since the submission of this paper for publication, studies of controlled aircraft crashes have shown the duration of deceleration of dummies restrained with the regulation restraining harness to vary from 55 to 90 milliseconds. This enhances the usefulness of the impact decelerator for continued investigations in aviation safety.

Letters to the Editor

Suggestions Regarding Principles Acting in the Use of the Bantu Divining Basket

Throughout the Bantu tribes in Africa the divining basket plays an important part in the life of the people. In times of concern and anxiety over illness, the absence of relatives, or adverse agricultural and economic conditions, the services of the diviner are sought. He is an important figure in the community and has learned his art while a young man from an older diviner. The divining basket is a woven basket containing 40–80 articles and covered by a lid. The articles can be described as fetishes, images, and objects having symbolic representation, such as a wounded man, a pregnant woman, etc. For example, the basket usually contains: a duiker horn, the wide open end at the base signifying 'mouth' (''a scolding mouth,'' ''one who talks too much,'' etc.); a piece of organic tissue representing the placenta; white chalk, meaning innocence; a turtle bone, signifying a patriarch of the family; a piece of stone worn smooth by running water, which means that the patient is being worn down by one pain or trial after another. The diviner shakes the basket in such a way as to manipulate any article to the top of the pile. He then prophesies from the basis of the article at the top of the basket. On many occasions the diviner makes a prophecy which is fulfilled.

It is suggested that two factors are important in the success of the diviner. One is that he is conversant with the situation from local gossip and his position in the village. This is recognized by his clientele, who frequently seek the services of a diviner from another village, fearing that their local diviner may manipulate the fetishes so as to render a course of action favorable to his personal interests or the interests of his vested group.

The second suggestion is that the diviner uses the objects in the basket as a projection test, comparable to Rorschach's Psychodiagnostic Plates. Although he does not insist that his client discuss each object brought to the top of the basket, he has been observed to watch his subject closely, apparently for any responses, verbal and nonverbal. It has been noticed that in the absence of a response to a certain object the diviner will shake the basket again, bringing a different article to the surface. It seems reasonable to presume that over years of experience, working in a specific society, the diviner has learned empirically the characteristics of responses which are related to different types of individuals under various stresses. By observing facial responses, bodily gestures, any exclamations or remarks, and reaction times, he could appraise the individual from these projections, and with a knowledge of local situations he could render a decision which would be more likely to be adequate than if chance alone were the only factor operating.

This hypothesis has been advanced to attempt to relate an important phase of Bantu life, which on first atten-

tion might seem to have supernatural connotations, to psychological tests in the field of perception and apperception, such as the Rorschach Technique and the Harvard Thematic Apperception Test.

JOHN M. PARKER
School of Hygiene, University of Toronto

Meteor Trails on the Moon

In *Science* (1946, **104**, 448) there is a letter from James Bartlett, Jr., explaining his concept of what N. J. Giddings, of Riverside, California, saw and described as "flashes streaking across the moon." I should like to discuss briefly Mr. Bartlett's explanation and show not only that it is contradictory to simple facts that can be secured by careful observation of the new moon at twilight, but that his statement that the meteorite trails would be visible only with the dark surface of the moon as a background is quite in error.

First, the new moon, if observed carefully, will be found to show, up to the fifth or sixth day, the usual "earth shine" phenomenon; the side that is not directly illuminated by the sun is not entirely dark, but reflects secondarily light that has first been reflected from the earth. Thus, the "dark" portion of the moon is actually lighter than the surrounding sky, and if meteor trails were visible against the "earth shine" illuminated disc, they certainly could be seen against the surrounding darker sky.

Accordingly, Mr. Bartlett's statement that the meteor trails "would be visible for *just that portion of their path* which had the dark side as its background" is thought to be quite in error, as the "dark side" of the moon is at least no darker than any other nearby part of the sky and is usually somewhat lighter due to "earth shine." Thus, a meteor would, in theory at least, be no more visible over the moon's darkened disc than elsewhere in the sky and would possibly be less so, if of a very faint magnitude.

Whatever might be the true explanation of Giddings' observation, I feel Mr. Bartlett's theory, although ingenious, is fundamentally unsound.

FRANK L. TABRAH
Black River Falls, Wisconsin

The communication from James C. Bartlett, Jr., concerning the projection of meteor trails on the moon (*Science*, 1946, **104**, 448) reopens the fascinating possibility originally observed and reported by N. J. Giddings (*Science*, 1946, **104**, 146).

However fascinating the original observation was, the reasoning followed by Bartlett is even more amazing. He says, in substance, that meteors entering the earth's atmosphere would not have been seen against the bright sky but, crossing the *dark* surface of the moon, would be visible.

How is this dark surface of the moon to shine darkly through the scattered atmospheric light which comprises the sky? Is this some new and visible manifestation of the "black light" we so often see headlined in the popular press? Bringing the dark portion of the crescent moon to this side of the sky so that it can be darker than the sky reminds one of the pictures of the horned moon with star embraced therein.

Records of previous observations of lunar flashes would be timely, as well as a written, brief, and "courteous discounting" by the authority first consulted by Giddings.

JOEL MANN MARTIN
Key West High School, Key West, Florida

On the Concepts of Mitosis

A lag exists between our concepts of mitosis as taught at the elementary and graduate levels and the picture as it has emerged in the last decade. The average biologist thinks of nucleolus and chromosomes as lying free and unoriented in the karyolymph and of the metaphase plate as the product of forces of attraction and repulsion between chromosomes and central bodies operating in a more or less uniform field.

For 10 years I have been analyzing the movements of nuclear chromatin in relation to the topography and movements of the cytoplasmic elements in the grasshopper follicle and onion-root tip meristem. Several important features have come to light:

(1) The centromere, and often the telomere regions, maintain association with the nuclear membrane throughout the interphase or "resting" condition.

(2) The nuclear membrane plays a role in the formation of the metaphase plate, which becomes a rough projection in one plane of the relative positions occupied by chromosomes at prometaphase.

(3) Heterochromatic regions are for the most part those associated with the nuclear and nucleolar membranes. Chromatin in the condensed state tends to be associated with these membranes. In fact, chromatin at all its levels of integration seems to be associated with the surfaces of structures of which it forms a part.

We may now superimpose upon the above the following established facts and current assumptions:

(4) The chromosomes in the interphase of rapidly dividing cells maintain their telophase polarity. Even in longer interphases, where the chromosomes shift positions considerably, this polarity is never wholly lost.

(5) The nucleolus is typically borne on definite loci of definite chromosomes.

(6) The centromere, telomere, and nucleolus-organizing regions are usually heterochromatic. Conversely, the bulk of heterochromatin is located in these regions. Centromere and telomere concentrations are known as chromocenters.

(7) Centromeres and telomeres have many properties in common.

(8) These regions are sensitive to external conditions.

(9) They are frequently associated with concentrations of cytoplasmic bodies.

(10) In many plant cells (e.g. *Allium*) they reflect cell polarity. The larger, usually more numerous proximal chromocenters are on the nuclear membrane in the region of the active division pole, and the smaller, less numerous distal chromocenters are located at the opposite, less active pole.

(11) The region just outside the nuclear membrane shows greater oxidation activity and higher concentration of ribose nucleic acid.

(12) Cytogenetic evidence from translocations suggests that heterochromatin and centromere regions exert a gradient of effect along the chromosome, manifest both in nucleic acid disturbances and genetic effects.

(13) The heterochromatic regions are thought to contain nonspecific *polygenes*, more or less cumulative and indeterminate in their effects, as opposed to the specific, saltational *oligogenes* of euchromatin.

(14) The heterochromatic regions are thought to be regions of nucleic acid synthesis.

(15) The constituents of nucleic acid are also constituents of the O/R-phosphorylation mechanisms preeminently concerned with energy metabolism.

From a synthesis of these facts, the following hypothesis may be derived:

(1) Heterochromatin as substance and the centromeres, telomeres, and nucleogenic regions as loci, are in some way concerned with transfers of energy and/or substance across the nuclear and nucleolar membranes. Painter (1945) suggests a heterochromatin → nucleolus → cytoplasm cycle; I believe the circuit (a) may include other elements than the ribose ⇋ desoxyribose cycle and (b) may, in some cases, proceed in the reverse direction. Heterochromatin would thus be "liaison chromatin."

(2) From their behavior and topography chromosomes appear to be lines of transfer of energy and/or substance traversing the distances between the heterochromatic junctions.

(3) The metaphase period of maximum chromatin condensation with its minimum of surface area may also be specialized for energy transfer. In view of (11), (14), and (15) above, the transactions may be those concerned with energy metabolism. Such function may be the common denominator of all pycnotic chromosomes and chromosome regions.

(4) The nonspecific, quantitatively indeterminate polygenes of heterochromatin may be nothing more than effective concentrations of the constituents of nucleic acid participating in energy metabolism.

(5) The strategic location and direct participation of heterochromatin in energy metabolism would explain many of its properties and functions, especially its connections with cytoplasmic metabolism, and its apparent pacemaking role in neoplasia and variegation.

In short, *the various forms which chromatin assumes, and the changes which it undergoes in the mitotic cycle, may be a shifting series of pathways along which transfers of energy and substance are taking place between chromosomes and karyolymph and between nucleus and cytoplasm.*

The topography of the cell would thus be visible reflection of its function as an energy transformer.

The above thesis, expanded into a more detailed hypothesis, will appear elsewhere at a future date.

LEON VANDERLYN
Biological Abstracts, University of Pennsylvania

Book Reviews

Longleaf pine: its use, ecology, regeneration, protection, growth, and management. W. G. Wahlenberg. Washington, D. C.: Charles Lathrop Pack Forestry Foundation, in cooperation with the Forest Service, U. S. Dept. of Agriculture, 1946. Pp. xxii+429. (Illustrated.) $5.00.

This is a concise and clearly presented synthesis of the voluminous empirical and fundamental information that has accumulated through years of research on the silviculture and management of one of America's most valuable forest trees. It should be of great service to practicing foresters, scientists, students, and teachers. The introduction clearly defines the longleaf pine problems.

Part I gives a well-illustrated summarization of technical data on resources, commercial uses, and wood and pulping properties of the species. Major economic uses are naval stores, piles, poles, posts, ties, mine timbers, lumber, and pulpwood. Less than half of the volume of wood was utilized until the pulp mills began converting the tops into paper. In second-growth forests, the species is being gradually replaced by slash pine in the coastal areas.

Part II covers the ecology of the species, including such items as site, climate, soil moisture, and soil fertility. An entire chapter is devoted to the much-discussed role of fire in regeneration. The author cautiously concludes that fire is advantageous in five of six conditions that prevent successful natural regeneration.

Part III is a very fine assemblage of information relating to the role of seed production, soil fertility, seedling development, and seedbeds in natural and artificial regeneration. Again the author recognizes the essentiality of fire for regeneration. The importance of leaving seed trees on cutover areas is stressed.

Part IV evaluates the damage and losses caused by fire, insects, animals, and climate. Damage from insects and disease can be minimized by improvement cuttings and thinnings. Chapter 8 is devoted to an analysis of the fire situation in the longleaf pine region, including behavior of fires, effects of fire on stands, mortality, fire control, and protective burning. The author concludes that periodic, controlled burning is advantageous. Uncontrolled burning may reduce diameter and height growth by approximately 20 per cent.

Part V discusses briefly the management of longleaf pine forests for naval stores and timber production. The chapter on naval stores is authoritative and up to date, and considers such items as chipping methods, effects of fire and weather on gum yields, and chemical stimulation. Treating freshly cut streaks with 60-per cent sulfuric acid should increase gum yields by 60 per cent or more. The management system recommended is clear cutting with seed trees scattered or in groups.

In addition to the text, the volume contains 11 appendices, a 12-page glossary, a bibliography of 637 citations, 48 plates, and 74 figures.

L. W. R. JACKSON
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Insect microbiology: an account of the microbes associated with insects and ticks with special reference to the biologic relationships involved. **Edward A. Steinhaus. Ithaca, N. Y.: Comstock Publishing Co., 1946. Pp. x + 763. (Illustrated.) $7.75.**

For a long time there has been need for a real evaluation and synthesis of the literature dealing with the microbes of insects and Acarina. Various groups of specialists have concerned themselves with one or another of the groups of these microbes, but the literature was so widely scattered that few of the specialists could become familiar with it. Systematic bacteriologists and protozoologists have studied microorganisms from insects but have usually been interested primarily in the microorganisms themselves. Economic entomologists have been interested in microbes which produce disease in insects because of the economic importance of agents that reduce the numbers of either beneficial or harmful insects. Again the medical entomologists, plant and animal pathologists, and medical and veterinary scientists have been concerned with that large group of microbes producing disease in plants and animals for which arthropods (insects, ticks, and mites) act as transmitting agents. These latter groups usually become concerned entirely with either the microbe or the arthropod, but few individuals develop a strong interest in the relationships between them.

Dr. Steinhaus' book represents an attempt to evaluate this widely scattered and heterogeneous literature (of over 1,600 references). The book may properly be called an introduction to a new science—the science treating of the interrelationships of arthropods and their associated microorganisms, including the extracellular bacteria, the intracellular bacterium-like and rickettsia-like symbiotes, rickettsiae, yeasts, fungi, viruses, spirochetes, and protozoa (but not the nematodes). Considerable attention is given to the associations known as mutualisms, thus bringing to the attention of students of parasitism those interrelations which probably are vastly older than the parasitic relationships and an understanding of which will undoubtedly throw light on the latter. The bacterium-like and rickettsia-like symbiotes which have established such very close relations with their hosts' tissues and life cycles that they have often been mistaken for organelles and organs of the host are described at some length. They grade imperceptibly into forms similar in appearance, which apparently do little or no harm to their arthropod hosts but which may produce deadly disease in the vertebrate hosts. A chapter is devoted to the protozoa in termites, which have much interest from the standpoint of the evolutionary and physiologic aspects of the mutualisms existing between them. The natural and acquired immunity of insects to microbes is discussed in a separate chapter, and the principles illustrated are related to vertebrate immunology.

The book should do much toward stimulating investigators to enter this new and interesting field of study.

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Apes, giants and man. **Franz Weidenreich. Chicago: Univ. Chicago Press, 1946. Pp. vii + 122. (Illustrated.) $2.50.**

Since the discovery of the first *Pithecanthropus* skull in 1891–92 and the first *Sinanthropus* skull in 1929 much additional material has come to hand—so much, in fact, that apparently Weidenreich feels that we must be prepared to reorient our thinking about man's early evolutionary history.

Perhaps the most startling conclusion offered by Weidenreich is that "giants may be directly ancestral to man." As the bases for this assertion there are (1) three giant molars found by Von Koenigswald in a Hong Kong apothecary shop and termed by him *Gigantopithecus blacki* (although Weidenreich says they are hominid); (2) a mandibular fragment found by Von Koenigswald at Sangiran, Java, and called by him *Meganthropus paleojavanicus*; and (3) a skull found by Von Koenigswald, also at Sangiran, called by Weidenreich *Pithecanthropus robustus.* It is Weidenreich's feeling that these three are, more or less in order as given, in linear relationship to the *Pithecanthropus erectus–Sinanthropus pekinensis* group, who, in turn, are ancestral to *Homo sapiens.*

Weidenreich affirms vigorously that the nomenclatural plethora is not to be construed in terms of the Linnaean binomial taxonomic system. The names are, for the most part, merely "Latinizations" of descriptive and/or place names. Indeed, the author is prepared to admit that *Pithecanthropus erectus* and *Sinanthropus pekinensis* are true hominids, referable to the genus *Homo.*

The book also contains chapters on the classification of modern races and on the phylogeny of brachycrany.

Weidenreich has done human paleontology a yeoman service in thus presenting his views. It is no evaluation of him, but rather of the material, when we suggest that the lineal arrangement of *all* the above-named fossils (so that they are in a direct line to *Homo sapiens*) is an assumption that rests upon certain dentocranial characters known to be quite variable. The possibility of relationship is one thing, the probability another. We would wish for a better knowledge of the range of variation before we write Q.E.D.

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